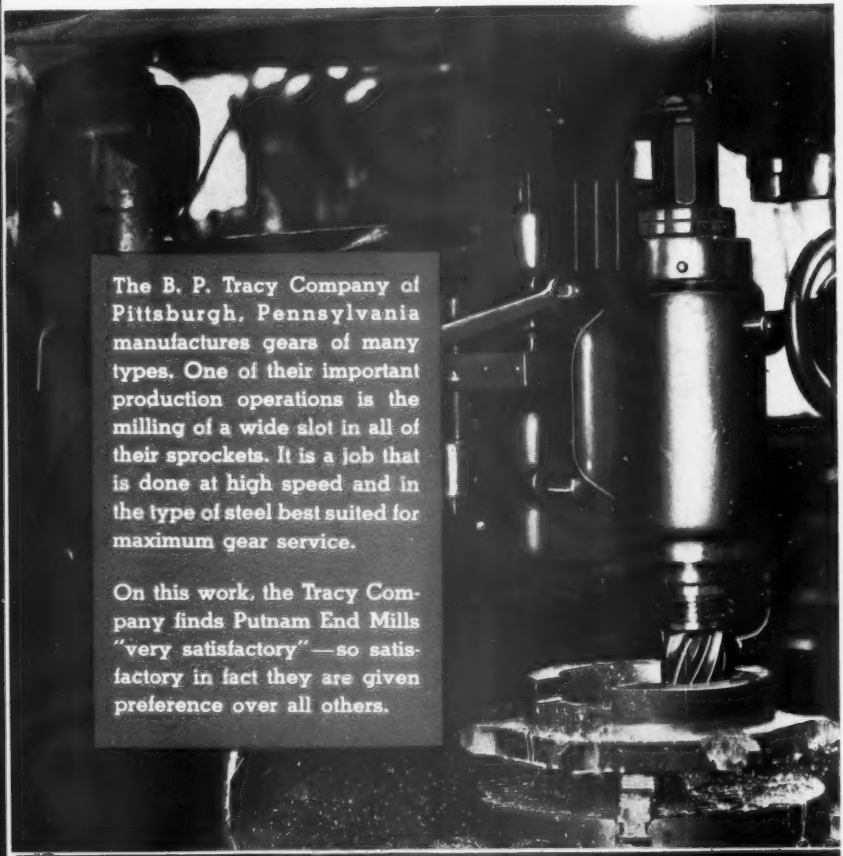
The TOOL & DIE Journal
Tool-Die-Machine PROGRESS

The Hardest Steels Can't Stop PUTNAM HI-SPEED END MILLS

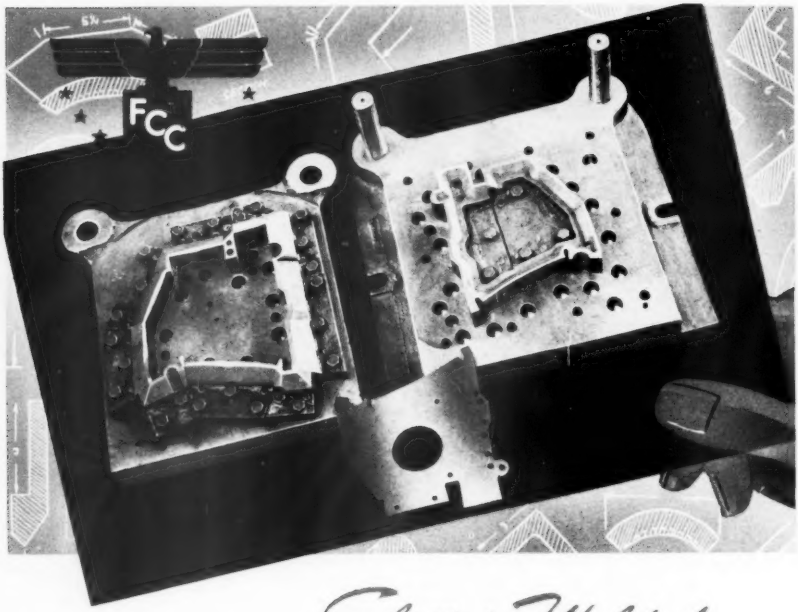


The B. P. Tracy Company of Pittsburgh, Pennsylvania manufactures gears of many types. One of their important production operations is the milling of a wide slot in all of their sprockets. It is a job that is done at high speed and in the type of steel best suited for maximum gear service.

On this work, the Tracy Company finds Putnam End Mills "very satisfactory"—so satisfactory in fact they are given preference over all others.

PUTNAM *Hi-Speed* END MILLS

PUTNAM TOOL CO. • 2985 Charlevoix Ave. • Detroit



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2. **Screw and dowel holes easily drilled after machining and hardening operations.**
3. **Expensive lapping operations eliminated.**
4. **Secure fit of sections on die shoes.**
5. **Slight warpage easily straightened.**
6. **Greater hardness can be used on cutting edges because the tough, soft steel backing acts as a cushion.**
7. **By the use of electrically welded composite, savings of anywhere from 18% to 38% are secured over the use of bar stock tool steels, depending upon the shape and type of selections.**

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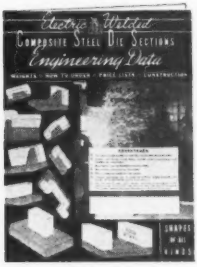

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The TOOL & DIE Journal

Tool-Die-Machine PROGRESS

Editor George J. Huebner

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Circulated monthly to executives and department heads responsible for designing, building and using Precision Tooling.

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Official Organ of the Special Tool, Die and Machine Shop Institute

Vol. 7 APRIL, 1941 No. 1

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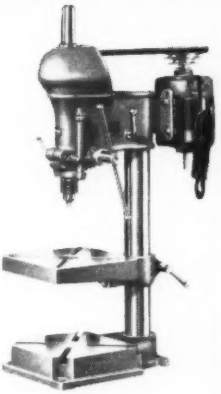
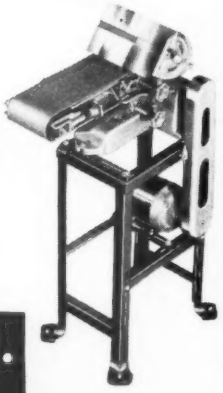
The tools described here do not comprise the complete Duro Line. Write now for a copy of our 1941 Catalog, a post card will do.





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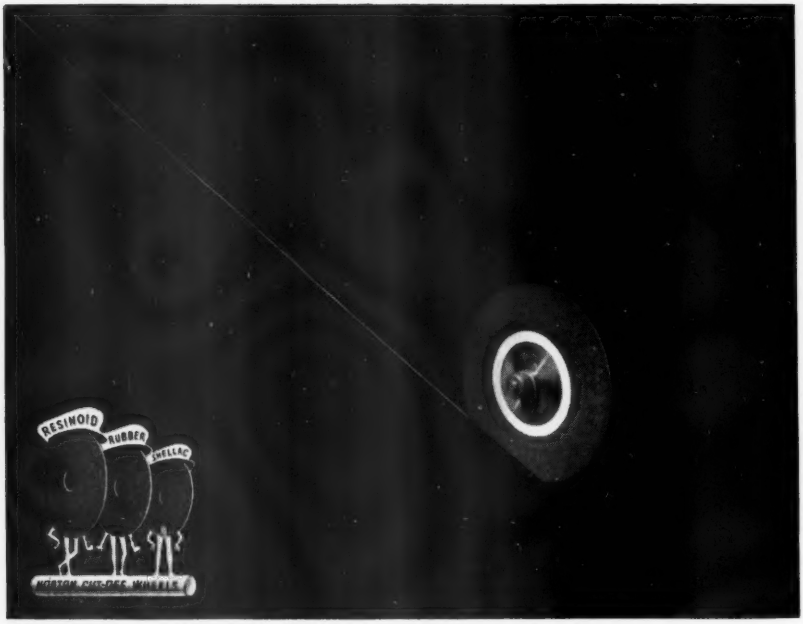

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W-796A

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for use in the Tool Room or on the Production Line

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M-435

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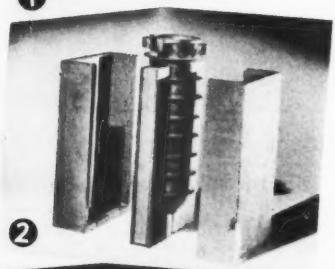
The high cost of producing chuck jaws for holding irregular shaped pieces during machining operations can, in many cases, be greatly reduced by the use of Cerromatrix. A typical example is shown in the five photographs. Figure 1 shows the essential parts for making the chuck. The spacers were made by nailing two thin strips of wood to a thicker center piece, leaving a groove on the inside the length of the spacer. The thin side pieces are sawed to fit the radial ridges on the die casting, and then the grooves of the spacers are filled with Babbitrite. The spacers are then pressed against the casting to make the impression. Figure 2 shows the casting in position between the spacers which act as separators during the pouring and support the die casting in the correct location with relation to the retaining shell. The two halves of the shell are then clamped in position against the spacers as shown in Figure 3. The Cerromatrix is now melted. It should be stirred well during melting. The pouring temperature should be between 300° and 350° F. Figure 4 shows the completed chuck jaws. The jaw cavities are just deep enough to hold the casting in alignment during machining. Spacing between halves of the chuck is wide enough to keep the movement necessary in opening and closing the jaws to a minimum (see Figure 5). Send for literature describing other jobs.

1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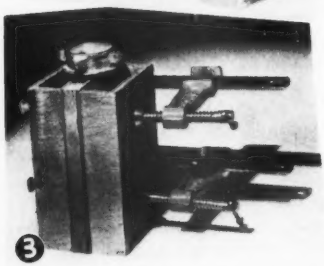
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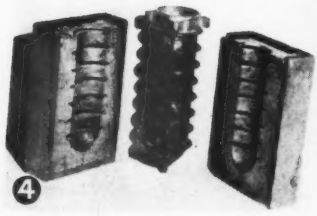
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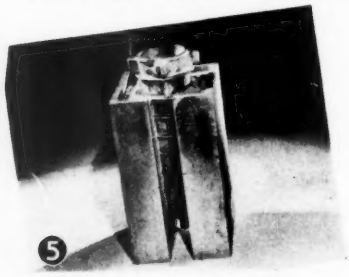
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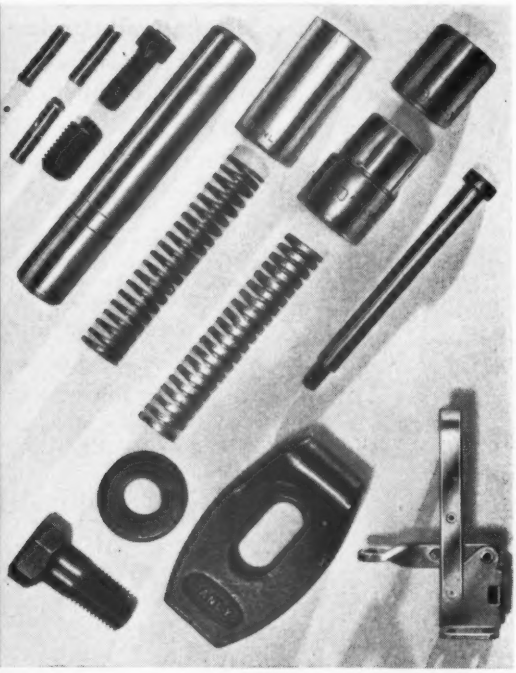

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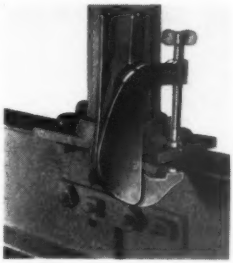
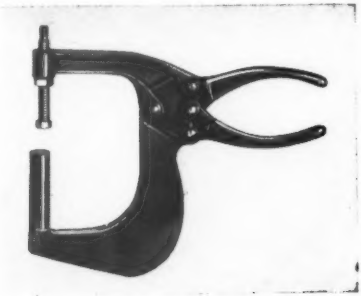
KNU-SINE series with hinged bases — Toggle Clamps of this type may be set at diverse angles to suit the part without further machining.

Type KV series with fixed base used extensively in the aircraft and automotive industries where a fast action, inexpensive clamp tool is required.

BELOW: NEW Type 455 Toggle Pliers with four inch deep jaw. Drop forged steel hardened and tempered.

KLAMPACTO "C" Clamp—Toggle action — combines the advantages of the conventional "C" Clamps with high speed Toggle action — designed for heavy duty structural work — 5 inch throat capacity.





Send for Catalog No. 5.

KNU-VISE TOGGLE TOOLS ARE USED IN VIRTUALLY ALL PHASES OF INDUSTRY FOR HOLDING PARTS DURING AN OPERATION—FAST, DEPENDABLE, INEXPENSIVE

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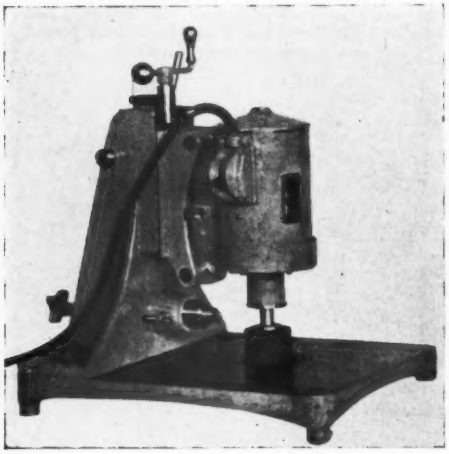
The *Companion Work Bench*, as shown, is equipped with vise and hand tools for final fitting, layout or assembly. Saves by reducing shop traffic.

SPECIFICATIONS:

Height .....Approx. 58 inches
Floor Space .....Approx. 29" x 33"
Weight .....Approx. 600 lbs.
Motor: 1 HP—1750 RPM—220 or 440 V.
Grinding Wheels: 8" dia. 3½" face.



The *Grindrite Jr.*, a portable bench type grinder, is unusually rugged for its size and weight — it is of particular value in shops which handle a large number of small dies and die parts.

Literature on both the regular ***Grindrite*** *and* ***Grindrite Jr.*** *will be sent on request. Ask for Catalog and also list of users.*

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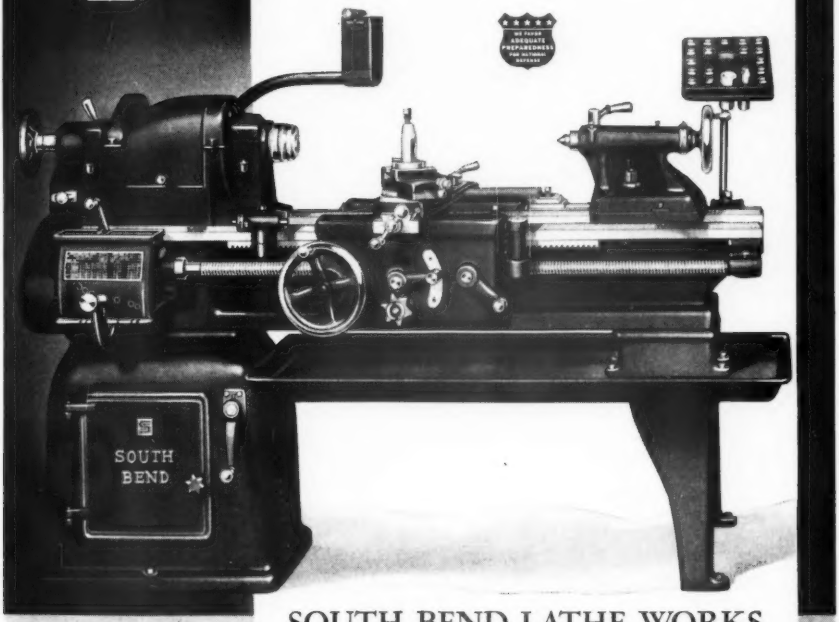
South Bend Lathes have extreme precision and ample speed for turning out work efficiently and profitably. They are giving satisfactory service in the tool rooms and production shops of America's topmost industries.

South Bend Lathes are manufactured in five sizes, 9" to 16" swing. If you are considering the installation of a lathe, write today for our new catalog describing the New Series "S" South Bend Lathe.



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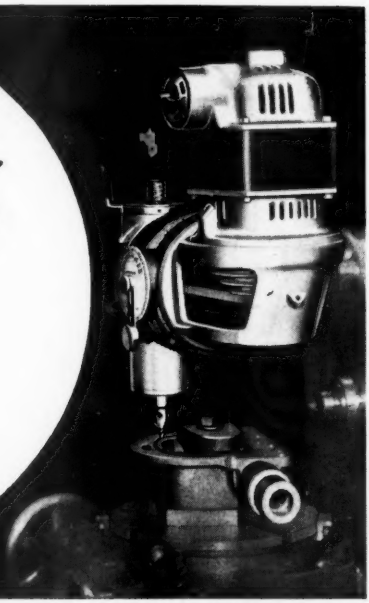

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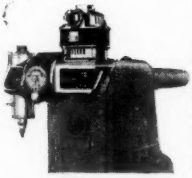
KEARNEY & TRECKER CORP., MILWAUKEE, WISCONSIN, U. S. A.

The "THOU-METER" —exclusive with the Milwaukee Midgetmill. Set cutting tools by direct reading — merely touch tool to work, set dial at zero, and mill, drill and bore until dial shows correct reading — in thousandths. No graduations — dials — stops — binding screws. Accurate to plus or minus .00025 in. in its 2½ in. of travel.



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Write now for complete information on the MILWAUKEE MIDGETMILL and SPEEDMILL — built to the same quality standards as Milwaukee Milling Machines.

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The TOOL and DIE Journal

TOOL—DIE—MACHINE PROGRESS

APRIL, 1941 Vol. 7, No. 1

Manufacturing Process for 75-90-105 and 155 MM Shell

By William Reiff, Jr.
Cleveland Duplex Machinery Company

The favorable reception which Mr. Reiff's two articles on "Nomenclature of Modern Projectiles" received prompted our urging him to prepare two additional articles, this and a companion article on the "Manufacture of Cartridge Cases"—which will appear in an early issue. This, like Mr. Reiff's first two articles, is designed to give the die shop and toolroom man a clear perspective as to the place in which the sub-contract work he is doing, or may do, fits in the National Defense Program.

This material has been reviewed and furnished in part by the Cleveland District Office of the Ordnance Department, United States Army.

—The Editor

OPERATION No. 1	CUT UP BILLETS
Equipment:	Hack Saw Circular Saw Flame Cut
OPERATION No. 2	FORGE—ROLL (Witter Process)
Equipment:	Hydraulic or Crank Presses Forging Machines—Double End Method Furnaces Required For Above Operation: Rotary Type Salt Bath Induction Method
OPERATION No. 3	SHOT BLAST (to remove scale)
OPERATION No. 4	CENTER
Equipment:	Centering machines, both horizontal and vertical, or on plain and automatic lathes and turret lathes.
OPERATION No. 5	CUT-OFF
Equipment:	Hack Saw Circular Saw

Method: Sometimes center and cut-off operations are performed simultaneously.
This is an alternate set-up also done with rough turn operation.

OPERATION No. 6 **ROUGH TURN—CUT OFF FACE BASE AND FORM THE BOSS**

Equipment: Turret Lathes
Automatic Lathes
(The Cross Gear and Machine Co. have a new type of lathe especially adaptable to shell work)

OPERATION No. 7 **COLD NOSE** (155 mm Hot Nose)

Method: This is a very controversial question. The Ordnance Department claims it can be done. However, Canada is hot nosing all above sizes, as abrasion of dies is costly when cold nosing.
(To Hot Nose heat nose to 1850° F in lead bath, salt bath, induction or slot type furnace.)

NOSING

Method: Sometimes accomplished in a swaging machine. In this method either the dies or the work may be rotated. Hot nosing of large shell under press will generally require two operations.

WEIGHING

Method: In order to maintain the weight within prescribed tolerances it may be necessary to weigh shell one or more times during machining operations. Underweight shell will be rejected at the earliest time to avoid unnecessary machine work. Overweight shell will require further machining in the "hospital" or adjustment of tooling.

OPERATION No. 8 **FINISH TURN AND FACE**
(same as rough turn)

OPERATION No. 9 **DRILL AND TAP SET SCREW HOLE**

Equipment: On 75 mm, 90 mm and 105 mm, automatic dial type equipment for drilling and tapping, such as Bodine Corp. furnish, is excellent for high production.

Any standard drilling machines and tapping machines are used however. All shell have same size hole $-\frac{5}{16}-18$ thread (some shell have no set screw hole).

OPERATION No. 10 **FINISH BOTH ENDS**

Equipment: Automatic Chuckers
Turret Lathes
Tapping or Threading Machines
Thread Millers (Plan-O-Mill Corp.)
Boring Machines

Method: Rough and finish bore, countersink, face, tap, cut off boss, face closed end, groove for band.

OPERATION No. 11 **NOTCH**

Equipment: Small hand millers with hand indexing fixtures. (Cross Gear and Machine Co. have an excellent semi-automatic machine for this operation.)

Method: On 75 mm, 90 mm, and 105 mm there are five equally spaced notches in nose. Only one notch on 155 mm; some shell are not notched.

OPERATION No. 12 **STAMP**

Equipment: Standard Marking Machines

Method: Year of manufacture, size, style and initials of manufacture.

OPERATION No. 13 **KNURL BAND SEAT**

Equipment: Use Marking Machines whenever possible.

Method: 75 mm—Knurl
90 mm—Score
105 mm—Knurl
155 mm—Six waves per circumference and 5 ribs make 3 chisel cuts across ribs. Some bands are wide, others are narrow. Waving is not always essential.

OPERATION No. 14 **APPLY BAND**

Equipment: Tire Setters Used.
Cut-off equipment and burring equipment are necessary for making bands.
Lake Erie Engineering Co. have an excellent hydraulic operated horizontal type machine that is fast yet not fatiguing to operate as shell are not lifted in and out of machine.
Some sizes can also be swaged on regular swaging machines.

(Continued on Page 34)

A **Reader Requested** Article

The Place of the Toggle Clamp in Speeding Modern Production

This material has been assembled from authoritative sources to illustrate the wide range of applications of toggle clamps and toggle pliers and to suggest to manufacturers the extent to which these accessories can be employed in the furtherance of economical design, production and assembly of many products. ***—The Editor***

THE toggle clamp, like so many other production and assembly accessories, is the result of efforts to achieve economies in designing time and in the construction or purchase cost of adequate holding devices. Such clamps must be of simple design, provide fast, positive means for holding stock or parts in position, be adjustable and speed production and assembly work.

The development of quick-acting toggle clamps in the last several years has been stimulated by the steadily growing demand for increased production. Beginning with the basic "C" clamp, many types or variations have appeared. In many cases, for example, clamps for aircraft parts assembly, the clamps have been designed to meet specific requirements. Several companies have specialized in the manufacture of toggle clamps and toggle pliers so that the numerous advantages of design, size, adaptability and price are now available to users of these useful tools.

A number of applications of typical toggle clamps made by three companies that manufacture the majority of such tools have been chosen to illustrate the wide range of uses for clamping parts in various types of fixtures for precision drilling, tapping, reaming, boring, welding and for parts assembly operations.

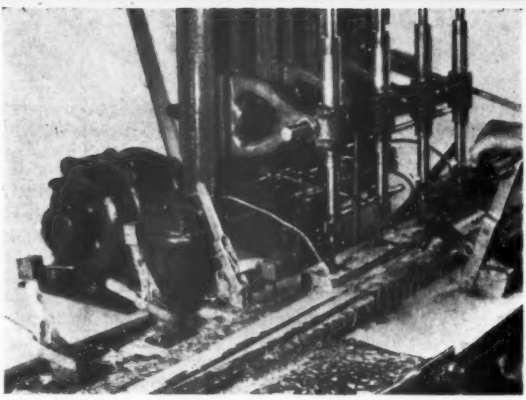
Fig. 1

Photo: Courtesy Detroit Stamping Company

A very common use of toggle clamps is to hold parts accurately for marking. Fig. 1 shows an operator center punching the work—steel strip—which has been placed in a grooved slot or fixture and the template locked in position by a hand clamp. The master holes in the drilled template assure accurate center punching. As the clamp releases instantly, the work can be inserted, adjusted or removed from the fixture.

Fig. 2 shows a more advanced production set-up for the same strip stock. The toggle clamp directly in front of the spindles forces the work to the back of the fixture and holds it securely as the first holes are drilled. The clamp is then released and the stock is guided to the second position determined by the first clamp to the left of the fixture. The

Photos on this page: Courtesy Detroit Stamping Company



Right, Fig. 2

pointed steel rod on the end of the clamp bar enters the first of the holes already drilled and is locked in place by the action of the toggle clamp. Thus the second series of holes is accurately drilled. Ease of locking and unlocking make for rapid action and high production.

Both clamps and toggle pliers must frequently be used where clamping space is limited. Fig. 3 shows two aviation model toggle clamps and a light duty model toggle pliers. The clamps measure only $1\frac{23}{32}$" by $1\frac{5}{8}$" at the base; raising the operating handle delivers a pressure ratio of 33 to 1 to the clamping arm. The toggle pliers shown measure $6\frac{15}{32}$" overall. A lock nut permits quick adjustment of the clamping head for space from 0" to $\frac{1}{16}$", providing efficient clamping for a wide variety of work. Closing the plier handles exerts a pressure ratio of 75 to 1 at the clamping ends. For this reason and because of their accuracy, pliers have replaced old type "C" clamps for many holding operations.

A new portable "C" clamp, with two holding rods, is shown in Fig. 4. The manufacturer states that the advantages of the standard "C" clamp and those of swift toggle action are combined in this new "C" style clamp. It is fast in action and can be used in a more limited space than the old style 'C" clamp. Two adjustable rods hold the work at exactly the desired spot. T-shaped pieces, impossible to handle with ordinary "C" clamps, can be held securely.

Many Applications for Two Rod Quick Acting Clamp

There are many applications for the two rod quick acting toggle "C" clamp. It can be adjusted to the approximate thickness at the point where the holding is to take place, opened wide and closed with the toggle action in a fraction of the time required to adjust the old "C" clamps. It may be used, for example,

Fig. 3

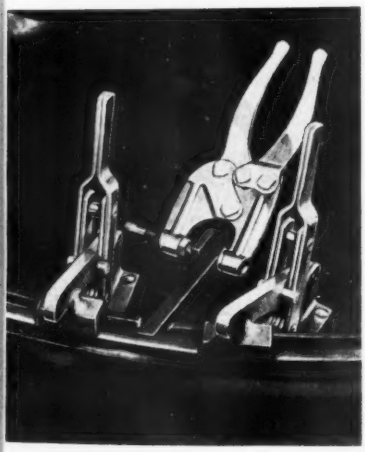
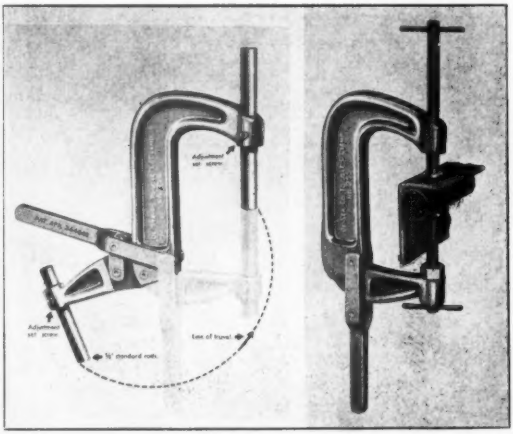


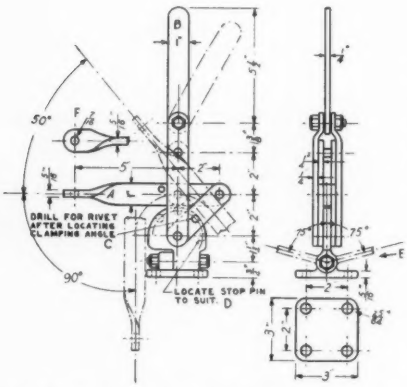
Fig. 4



to hold set metal parts on a bridge between perpendicular bars for welding. Given a distance within the capacity of the swing of the clamp, the space, say of 3", can be estimated, the necessary adjustment made, and by the movement of the toggle handle of the clamp, the bar ends bite into place and hold securely without need of further screwing or fastening.

Another leading manufacturer has greatly extended the range of applications of toggle clamps by the introduction of a new and exclusive construction in which all members revolve as a unit around the center pin in the semi-circular base. This permits any angle or compound angle to be obtained at the point of clamping with clamps mounted on flat or vertical faces of the die, jig or fixture. This eliminates expensive machining of angular pads. The method of applying the clamp is shown diagrammatically in Fig. 5. The clamping bar A is adjustable from the horizontal upward to 50° and downward to 90° from the horizontal. When the desired position of the clamping bar is determined, the base is drilled for riveting through the hole provided in the angular member C. The stop pin D is located to suit the job as it merely determines the position of the clamp when open. This fact is important because it often permits adjustment of the operating handle to clear over-hanging panels or to provide for better operating conveniences.

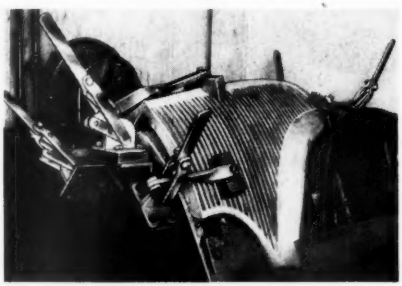
Fig. 5



The handle B, adjustable through 150°, is then adjusted to position. The handle bolt is tightened, lock washers holding the handle securely in position. Another decided operating advantage is the swivel E which provides a side-to-side adjustment of 75° to right or left. This swivel may be locked or left free to swing as desired.

The type of toggle clamp just described may be used on dies and for punch press operations, for clamping production parts in all types of fixtures for drilling, tapping, reaming, boring, welding, secondary press applications, sub-assembly and assembly operations. Fig. 6 shows a group of this type of clamp in use in an automobile grille assembly fixture. Also illustrated are several hold-down attachments formed to fit the contour of the work. The hole F (Fig. 5) at the end of clamping bar A may be tapped for the insertion of a socket head cap screw. The attachment may be welded, bolted or riveted to the clamping bar.

Fig. 6



Illustrations: Courtesy Danly Machine Specialties, Inc.

Aircraft Assembly Work

In assembly work, particularly in the aircraft industry, where many large assembly fixtures are now used, this type of clamp offers many applications such as fixtures for welding exhaust pipes to flanges, fuselage structural members, tail surface parts, wing and landing gear parts where the various aircraft members must be held in position for welding or other types of assembly. In the automotive field they are used on car body assembly fixtures.

The third manufacturer of toggle action tools builds a complete line of toggle

clamps, toggle pliers, hand squeeze riveters, linkage assemblies and knuckle action holding fixtures. The toggle clamps include a series of fixed base, a series of hinged base and a newer line employing cam rollers. This manufacturer's recommendation for installing standard fixed or hinged base toggle clamps illustrates the simplicity and effectiveness of these holding tools:

"After the tool or fixture has been laid out, and the clamping point decided on, the next step is to determine what size clamp to use and the type of base. The cast steel base should be first bolted or welded closely to the piece so as to receive the highest possible ratio of clamping pressure. The toggle mechanism is then added, and after bolting through center hole, swung into position, and dowelled solid. The toggle bar is then cut to the desired length.

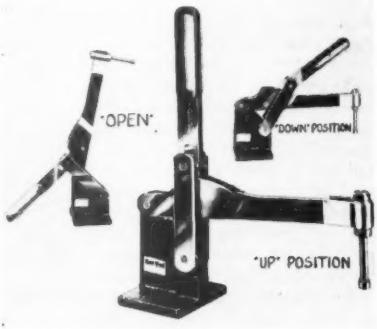
"Adjustment for wear may be obtained by adding the patented bolt retainer to the end of the toggle bar, welding or riveting firmly in position. The pressure pad is fitted to the part, and locked to the retainer with two jam nuts.

"Care should be taken, that too light a clamp is not used on heavy clamping operations, the continuous strain on the rivets eventually wearing them egg-shaped, nor should extensions to the handles be added, experience having shown that the dimensions are correct for the maximum pressure to be safely obtained."

Clamps with Cam Rollers

About two years ago this manufacturer introduced toggle clamps employing cam rollers. The action is similar to the regular toggle clamps in that the clamping bar is hinged at one end, the same type of operating handle and the same member for attaching to a fixture being used. Fig. 7 illustrates the operation. The link connecting the handle to toggle bar is slotted to permit this bar to be withdrawn rapidly from the work and has no actual part in the clamping operation. The upper portion of the toggle or clamping bar is machined to a cam surface against which two rollers are in contact at all times. When the handle is in the vertical position these rollers are contacting the low part of the cam surface and the toggle bar is in the maximum position to take the thickest part being held in the fixture. Continued swinging of the handle forces these cam rollers against the rise of the cam so that the toggle bar is eventually in the minimum clamping position. A clamping pressure of 50:1 is obtained with these clamps.

Illustrations: Courtesy Knu-Vise, Incorporated



Above, Fig. 7; Below, Fig. 8

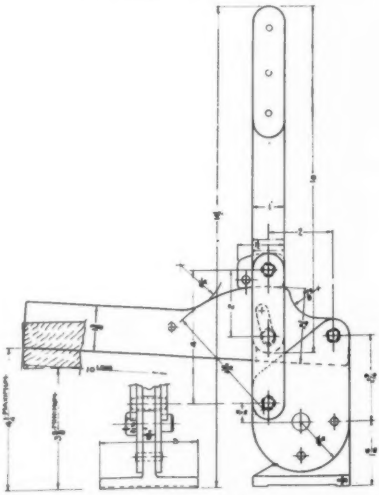


Fig. 8 shows a drawing of a cam roller toggle clamp in the "up" position (refer to Fig. 7). Note particularly the slot in the handle link, the relation of the cam surface to the position of the toggle bar and the hinged base. The cam design permits the clamping of more than one thickness at one set-up. Another feature of the cam roller toggle clamp is its ease of installation.

Photos: Courtesy Knu-Vise, Incorporated

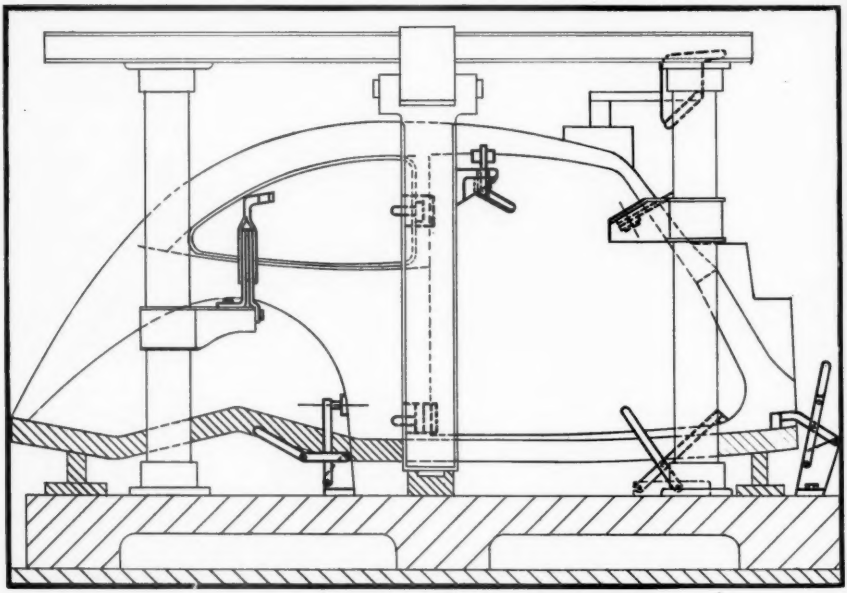
Right, Fig. 9

Below, Fig. 10

After the clamping bar has been cut off to the desired length, the clamp is bolted to the fixture in its approximate position. With the handle in the vertical position the pressure pad is affixed to the end of the clamping bar and set in place on a component of maximum dimension, thus permitting the full surface of the cam arc to be used when holding other pieces of a minimum tolerance. Toggle clamps with hinged bases have the advantage that they may be set at diverse angles to suit the part without further machining.

Figs. 9 and 10 show typical examples of multiple installations of both standard and cam roller toggle clamps for typical assembly jobs. Note in drawing Fig. 10 that only two of the nine clamps shown are installed identically.

Because of their simplicity, speed of installation, their ability to hold positively and because they eliminate many elaborate time-consuming set-ups, toggle clamps have won a place for themselves in the tool room and die shop, in the press room, in the production plant for hundreds of operations and in every plant where speed and economy in subassembly and assembly operations are essential.



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Suggestions on Drilling Procedure

By
Walter G. Holmes
Standards Engineer
The Timken-Detroit Axle Co.

By special request this section on Drilling Procedure from the Holmes treatise on Cutting Tools is published for the intrinsic value of its practical suggestions. These suggestions have been prepared from the experience of a number of outstanding shopmen and authorities on the best Cutting Tool practices.

Correct Procedure

DRILLING as a roughing operation produces clearance holes and those holes which are to be finished by reaming, broaching, grinding or re-drilling. Drills should be carefully ground, their outer corners rounded. A light feed should be used to prevent tearing of the part material, and with good working conditions and correct procedure the hole will be drilled without serious defects in finish, size, alignment, etc. An additional operation of reaming, broaching, grinding, etc., usually is more economical than devoting excessive time and care to an attempt to attain a high degree of accuracy with one drilling.

Where exceptional sizing or finish is desired in deep hole drilling, the usual procedure is to begin with a drill $\frac{1}{16}$ inch or $\frac{1}{32}$ inch under the finish size. This drill is then used to a depth of 8 diameters; a slightly smaller drill to its 8-diameter depth or until the hole is drilled to full depth. The hole is sized with a rounded-corner 3- or 4-flute drill which is passed through the depth of the hole. This procedure is economical and the operation can be performed within close limits on a hand screw machine or a drill press.

Chip Packing and Its Remedy

If chips clog the flutes, the drill must be withdrawn at frequent intervals to relieve them and to cool and lubricate the tool and the work. Some of the means for overcoming the chip packing condition are the use of drills with exceptional back taper, narrow margins and rapid spiral flutes; drills ground for curl-in chips; drills ground slightly off center for large hole drilling; improved cutting fluid application; and special heat treatment of the part material. Hard, stringy material and very soft material require frequent withdrawals of the drill after penetration to a depth of 3 diameters; free cutting steel after a 4-diameter depth; brass, copper, etc., after a 5-diameter depth; and in soft, crumbly materials such as cast or malleable iron, fiber, etc., withdrawal at depths, varying with the material, to as much as 15 diameters. The drilling of deeper holes in the various materials indicated requires additional drill withdrawals as the hole depth is increased. For the second step drill 50% deeper than for the first, and 30% of the first depth for each interval of drilling thereafter. The drill point will require more clearance than usual to provide a free cutting tool which will penetrate whatever chip packing may occur in the bottom of the hole. A pointer should be attached to the vertical movement of the machine, and an attached scribed plate used to determine the intervals of the drill withdrawal. The scale requires an elongated slot for setting to variable drill lengths and positions.

Horizontal drilling aids the chip removal but increases the difficulty of applying the cutting fluid. It is not practical for deep holes in tough, hard materials which require more efficient cutting fluid service but shows about the same efficiency for the materials which require a nominal cutting fluid service, and it is very efficient where cutting fluids should not be used, as for cast iron, fiber, etc.

Step Drilling

Hydraulic units are used as withdrawing mechanisms to facilitate removal of chips and to improve cutting fluid application. The insertion and withdrawal of a drilling unit is automatic and very rapid. Such units are used for single drills or with multiple spindle drill heads. The depth of cut for each step in the hole length, and the withdrawal of the drill when the limit of pressure is reached by the drilling action, are taken care of by automatic controls. Sharp drills must be used and advantages then include improved workmanship even with less-skilled labor, and a considerable reduction in tool and salvage cost due to less tool breakage.

The frequency with which a hydraulic unit may have to be set to withdraw a drill depends upon the service to be rendered by the drill and the grade of workmanship considered necessary. Therefore, the following must be taken into consideration: the accumulation of chips, the prevention of strain and drill breakage, the cooling of the drill and the part material, the prevention of hole tearing, running out, cutting oversize, drilling out of line, and other factors which will be recognized as each particular job is analyzed. Hydraulic units usually require drill withdrawal not more than once for each drill diameter of penetration, after the depth has reached 3 diameters. Small drills should be withdrawn each ¼ to ½ drill diameter to remove chips. The use of a comparatively short drill with a thick web, operating at high speed because of the short drill intervals, is considered more effective. Hydraulic units are usually sensitive enough to handle a small drill without hand feed or skilled operator attendance and even though small drills do not have sufficient flute area to allow the chips to travel up the drill and out of the holes, the breakage of a drill as it passes through the opposite side of the part is held to a minimum.

Hydraulic units are particularly effective when a drill encounters hard spots in the material. The increased resistance causes the drill to be withdrawn momentarily, cooling by the cutting fluid and washing away of chips before the drill is returned and again applied to cutting. This procedure is repeated until the hard spot is penetrated completely and a straight, round hole of full size is produced.

Drilling Deep Holes

The drilling of holes to a depth of 4 drill-diameters is best accomplished in automatic screw machines employing high speed and a comparatively light feed. For holes deeper than 4 diameters use a slower speed and a heavier feed to facilitate chip ejection. For deep drilling with automatics, drill points should be ground to sever the chips in a compact roll. This is accomplished by flattening the helical rake to about 10 degrees.

Combination drills are probably the most efficient in their removal of chips from deep holes. These have a smaller diameter which is about ⅔ of the drill's full drill diameter and it extends about ¼ of the drill length. If the smaller portion is longer, it will present additional drilling problems. Such a drill is ground to form two sets of chips with different coil diameters, the larger drill section cutting a chip flatter than that of the curled chip produced by the smaller diameter portion of the drill. The curled chips are formed in the bottom of the hole and as they travel up the flute, they push the longer, flatter chips ahead of them.

Use the station method of drilling on an automatic screw machine, then as the successive steps in drilling are reached at each station the cutting speed can be increased.

In the use of a turret lathe for drilling, be certain that it is level or the turret will not line up with the spindle and therefrom develop cutting conditions which lead to the breaking of small drills and center drills.

Very hard and tough materials like manganese steel and hard bronze require a heavy pressure for tool penetration. The material has a tendency to

(Continued on Page 49)

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Molds for Plastics Lenses

By C. Huber Whitlock

Molding Materials Staff
Plastics Division
Monsanto Chemical Company

THE use of synthetic plastics lenses has created a great deal of interest, particularly in the past two years or since a great improvement in suitable materials has been made. At present such parts as protective goggle lenses, camera finder lenses, small magnifiers and gas mask lenses are being molded of plastics materials. The use of plastics for lenses has very definite limitations—the most serious obstacle being that surface hardness of the plastics lenses is much less than that of glass and for that reason the plastics material is subject to scratching.

Assuming that a satisfactory molding material is used, the success or failure of making plastics lenses lies in the mold. In general, the mold design is in keeping with established practice. Due to the high pressures that are used in the molding operation, the design must be rugged to assure rigidity. Any flexing or misalignment in the mold caused by the high pressures results in lenses of varying optical properties.

The most important phase in the design is the method of producing the inserts or the parts of the mold which form the polished surfaces of the lens. There are two methods of producing these inserts—one by an electroplating process and the other by machining the inserts from a piece of tool steel. The electroplating method was first used for lack of a better method. This method is unsatisfactory for a production mold, as the inserts made in this manner cannot be hardened to the degree necessary to withstand molding pressures.

It was not an easy matter to find a steel from which these inserts could be machined. The requirements of a steel for this purpose are: that it be machineable; that it be susceptible to the heat treatment necessary to assure uniform hardness throughout the piece; that it be able to take a high polish; and that it be non-corrosive. Most important, such a steel should be absolutely free from porosity.

Numerous steels were investigated and it was found that a high grade, stainless steel would meet all the requirements. This steel had to be ordered from selected stock and in square or rectangular bars. Round bars should not be used as they cannot be forged to the same density as square bars. In selecting the bar sizes, the method of cutting the blanks from the bar had to be taken into consideration. It was necessary to stay away from the center of the bar for the polished surfaces of the inserts. The polished surfaces should be as near with the grain as possible. For this reason, the bar width should be such that it will permit the blanks to be cut so that the center of the bar forms the sides opposite the polished surfaces.

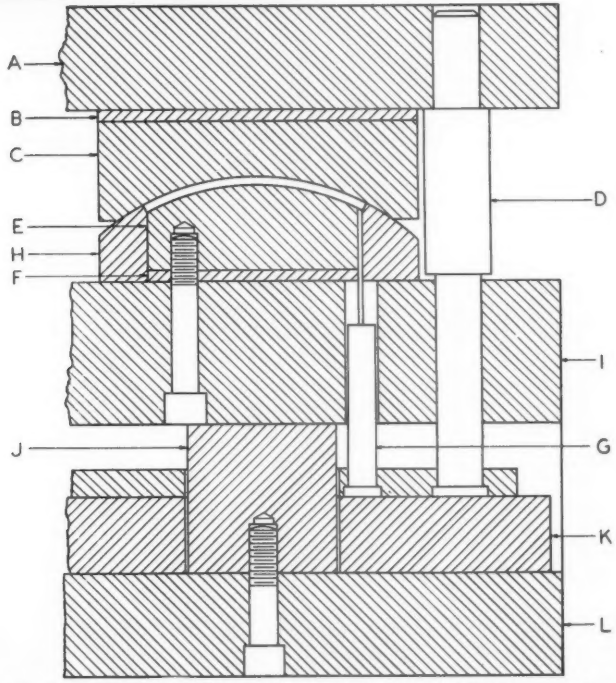
Due to the fact that in the grinding and polishing operation of the insert surfaces it is difficult to keep the tangent of the curve at the centerline parallel with the back surface of the insert, provisions have to be made to take care of any discrepancy in this operation. This difficulty in the grinding and polishing arises from the method used to do this work since a satisfactory polishing job

is accomplished only by means of a floating fixture. Consequently there is no mechanical control over the amount of metal that is removed by polishing, with the result that more metal may be taken off on one side than the other with no certainty of which side. Ordinarily this discrepancy is very slight if measurable at all. If this discrepancy is extreme, it would throw off the optical properties of

Left — Gas mask lens made from Crystallite

Below — Mold design showing principal parts:

A—Top cavity plate
B—Shim
C—Concave stainless steel insert
D—Push back pin for knockout plate
E—Convex stainless steel insert
F—Shim
G—Knockout pin
H—Cavity block
I—Lower cavity plate
J—Lower cavity plate support
K—Knockout plate
L—Mold plate



the lens. The method of correction is to cock the insert in the cavity and provide shims of at least one-eighth inch thickness which can be ground at an angle to assure the proper position of the insert in the cavity. It might be concluded that the insert could be ground on the back side to correct any errors in the polishing operation. However, it must be remembered that after the inserts are polished, the surface cannot be touched. All fitting of the mold must be done before polishing and the inserts are merely set into place when the mold is assembled.

The determination of the correct curvature of the inserts is a problem for the optical technician. The curves are determined from the specifications of the lens. The correct curve has to be ground on the inserts before polishing as the polishing fixture merely follows the curve and it is almost impossible to correct any discrepancy in the curve during the polishing.

In building molds for a cylindrical or irregular shaped lens where the axis has to be held in a definite location, it is important that fixtures be used for the machining of the inserts and the cavities. In order that the axis of the curves be held in exact parallel and not rotated, these fixtures are necessary, as a possible error in the set-up from one operation to another in the machining operations would cause trouble. Each insert should have two locating holes or a keyway on the back side accurately located to assure interchangeability to be used for all operations. The fixtures, of course, would have corresponding locating arrangements.

Heat Treatment

The heat treatment of the stainless steel inserts should be carried out with a great deal of precision. It is important that temperatures be used that will give a dense crystal structure. They should be tempered to relieve all strains but should be as hard as possible. The stainless steel found to be most suitable for this application is a 420 type* which contains the following: .30 to .40 carbon, 12 to 14 percent chromium with martensite as a predominate structure.

After heat treatment the inserts are ground and fitted to the cavity. The curve is ground with a very fine stone to give as smooth a surface as possible for the optical grinding and polishing operation. The optical polishing is done by an optical company. Great care should be used in handling the inserts after polishing as it does not take much to scratch them.

We have covered the polished inserts which are the heart of the mold and we should briefly comment on the design of the mold itself. Plastics lenses can be molded either by injection or compression molding. Each has its advantages and disadvantages. For all practical purposes the injection method is the best. In either case the cavity design is the same with the exception of a well above the cavity in the compression mold. The compression mold would be designed as a positive type.

If the mold is designed for the injection method of molding, the gate and sprue design are important. The gates should be as short as possible and larger than usual. There should be the cavity for the "cold slug" with sufficient space for all the cold material in the nozzle. The gate and sprue should be highly polished and all sharp corners removed. It has been found that rough surfaces in the gate will cause the material to swirl on entering the cavity, which results in the most troublesome problem of creating striae in the lens.

Consideration should be given to the best type of knockout arrangement. No set rule can be given here as every application has its individual problem in the knockout arrangement. Sufficient knockout pins should be used to remove the piece from the cavity with the least amount of distortion. The steel for the cavity can be any good grade of tool steel. All the cavity parts should be hardened as well as the pins. The cavity plates can be made from machine steel. Too much emphasis cannot be put on the necessity of grinding all parts of the mold to assure proper alignment. It will pay to make as good a mold as possible.

The nomenclature in this article follows that of the Nomenclature List in "Plastics Mold Designing" except that Mr. Whitlock calls the force or punch member and the cavity "concave insert" and "convex insert" respectively.

*The 420 type, the standard cutlery type, is the original Brearley stainless steel. It can be hardened to about C-53 to 54.

Fifty Years of Manufactured Abrasives

IN March 1891 Dr. Edward G. Acheson, while experimenting in the reduction of ores, noted that clay articles heated to high temperatures in natural gas-fired ovens became impregnated with carbon and seemed harder than ordinary fired clay. Determined to learn why, he built a small crude electric furnace out of a plumber's pot to which he attached two copper wires—one lead to the crucible, one to an arc-light carbon. After generating a very high temperature he allowed the contents of the crucible to cool. Apparently nothing had happened—until he noted a few minute crystals sticking to the point of the carbon electrode. Picking them up on the point of a lead pencil he found that they would not only cut glass, but would also scratch the diamond in his ring.

Not knowing what the crystals were, but suspecting them to be a mixture of natural aluminum oxide or "corundum" and carbon, he coined the name "Carborundum". Chemical analysis revealed that the new substance was silicon carbide.

Dr. Acheson built a larger furnace in his small plant at Monongahela City, Pa., and began to produce increasingly larger amounts of silicon carbide. The first crystals were sold to gem polishers at $880 per pound.

In 1895 when the first hydro-electric plants at Niagara Falls made electrical power available at low cost, Dr. Acheson moved his plant to Niagara Falls, where The Carborundum Company still operates its main works.

Realizing that his new abrasive, which is close to the diamond in hardness, would be of inestimable value to industry if made in wheels, Dr. Acheson attempted to get emery wheel manufacturers interested in its use. When their verdict was that it was impossible to make satisfactory wheels of silicon carbide, he proceeded to manufacture them himself, beginning with tiny mounted shapes now so popular for precision grinding. The first large order came from George Westinghouse, who used them for grinding joints in his new incandescent electric lamps.

(Continued on Page 41)

Why anneal?
Flat land equal to feed
Width=3 to 4 times feed
Depth=0.004" to 0.006"
KENNAMETAL CARBIDE TOOLS
MACHINE HARDENED TOOL STEELS
An ever increasing number of tool and die shops are finding that they can eliminate the time and expense of annealing—and achieve better results—by turning, facing, and planing steels heat-treated to over 550 Brinell, with KENNAMETAL-tipped tools.
Parts now being machined with KENNAMETAL, at economical speeds and with long tool life, include: Chuck bodies of Hyten steel (405 Brinell), lathe spindles of alloy steels (350-375 Brinell), extrusion dies of 12% tungsten and .60C for hot working brass (575 Brinell), and shear knife blades (502 Brinell). High carbon tap blanks and 18-4-1 steel blanks (annealed but highly abrasive) are being turned at 202-230 ft./min. and with remarkably long tool life, using KENNAMETAL K3H tools.
Save time by ordering standard or modified standard KENNAMETAL tools. Consult our catalog or send us your B/Ps.
McKENNA METALS Co
500 LLOYD AVENUE
LATROBE, PENNSYLVANIA, U.S.A.

Manufacturing Process for 75-90-105 and 155 MM Shell

(Continued from Page 19)

OPERATION No. 15 **TURN BAND**

Equipment:
Automatic Lathes
Turret Lathes
Manufacturing Lathes

OPERATION No. 16 **GRIND BOURRELET**

Method: Only necessary when turning equipment used does not produce satisfactory finish.

OPERATION No. 17 **WELD BASE COVER**

Equipment: Thompson Gibb Seam Welder

Equipment for machining base cover:
Punch Press
Slide Feed—(U. S. Tool Co.)
Stock Straightener
Stock Reels

OPERATION No. 18 **DEGREASE OR ALKALI WASH**

Equipment: G. S. Blakeslee and Co. have designed and furnished both types of equipment.

Method: Alkali wash consists of wash—hot water rinse—steam blow off and dry.

OPERATION No. 19 etc. **INSPECT, PAINT AND PACK FOR SHIPMENT**

GOVERNMENT INSPECTION

The Government Inspector will check all rotating band seats before application of the bands, and will observe other operations where this will facilitate the final Government inspection. Shell will be inspected for absence of grease and dirt before application of paint. Dimensional inspection will be applied to finished shell and not to forgings unless the latter are not produced by the same contractor who performs the machining operations.

Rotating bands will be cut off of sample shell to determine acceptability as to the seating of the band for an entire lot of shell.

PACKING

Shell up to 105 mm will generally be shipped in fiber or corrugated containers. Larger shell are shored into cars after the application of a rope or rubber grommet.

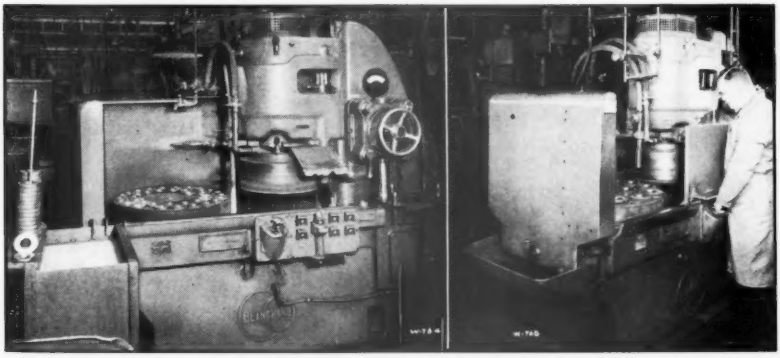
» » » *Keep them Moving*

WITH BLANCHARD SURFACE GRINDERS

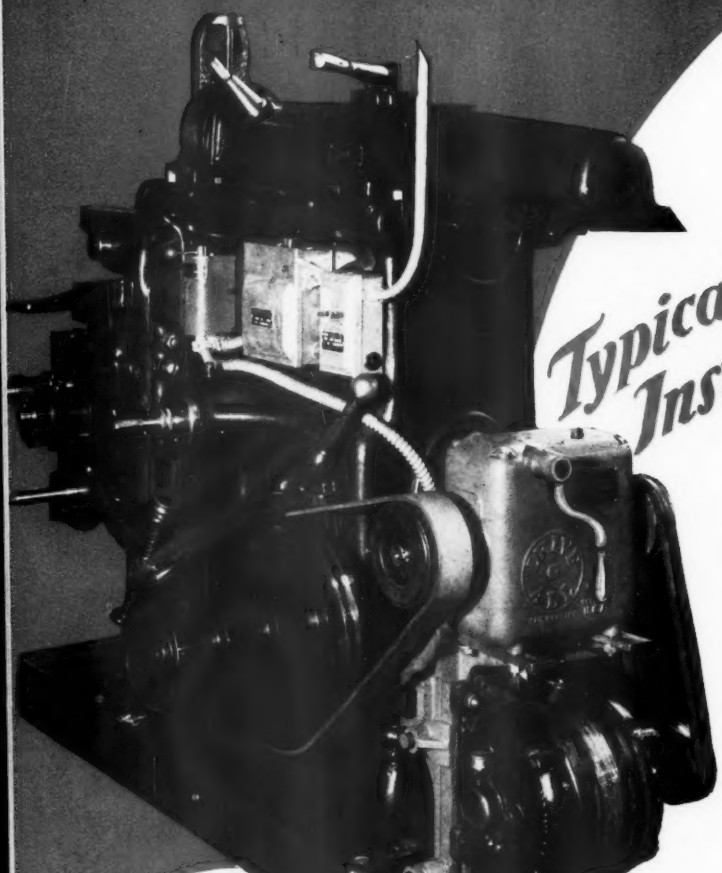
The largest manufacturer of automobiles in the world keeps transmission gears moving down the line by using Blanchard No. 18 Surface Grinders for grinding the gear faces. These machines not only assure maximum production, but easily give the accuracy necessary (parallel within .0005") for subsequent operations. Both faces of several size gears are ground on Blanchard No. 18 Grinders, .020" of stock being removed from each surface. Production on the 3½" gear is 250 (500 surfaces) per hour—and changing from one size gear to another involves practically no down time. Blanchard production estimates are yours without obligation—just send samples or blueprints to

BLANCHARD

THE BLANCHARD MACHINE CO.
64 STATE ST., CAMBRIDGE, MASS.

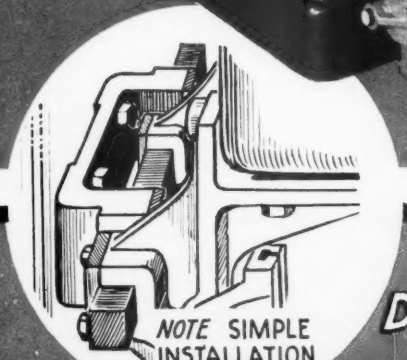


DRIVE-ALL



Typical Shaper Installation

Brackets Fi
Carried St
Brown



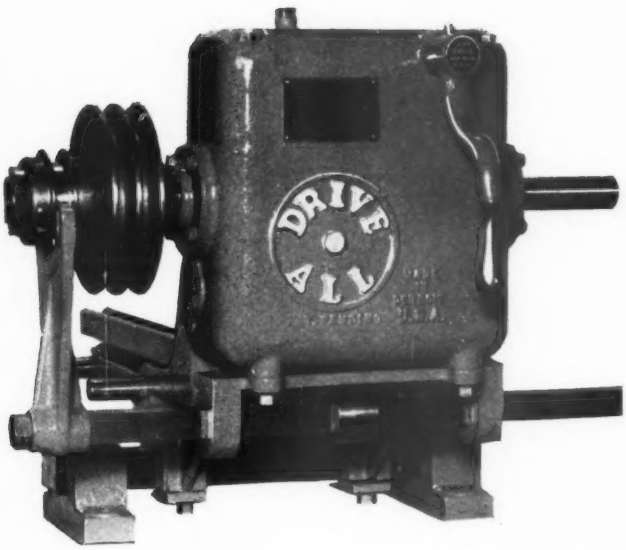
PROMPT DELIVERIES

DR
MANU
3400 (

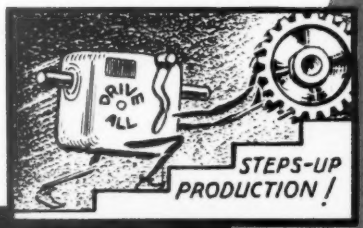
Motorizing Unit

with CLUTCH CONTROL

optional on all models!



Fit All Machines up to 10 H.P.
Stock. Also Special Units for
Brown & Sharpe Automatics.
(*Patents Granted*)



RIVE-ALL

UFACTURING COMPANY

Conner Ave., Detroit, Mich.

Mounted Wheel Chart Available

A WALL type mounted wheel chart showing in actual size the standard shapes and sizes of mounted wheels that are available for tool rooms, die shops and production parts manufacturers has been prepared by the Chicago Wheel and Manufacturing Company, manufacturer of the new V/T Super Bond Grinding Wheels. The chart will be found particularly helpful in checking shapes and sizes for special jobs. Specification tables make it possible for the user to determine at a glance the size of the mandril used with each wheel size.

A copy of this chart will be sent on request to The Chicago Wheel and Manufacturing Co., 1101 West Monroe St., Dept. TD, Chicago, Ill.

Cimatool Co., Sheffield Gage Form Sheffield Corporation

O. M. Poock, Dayton, president of the Cimatool Company, and C. H. Reynolds, Detroit, president of the Sheffield Gage Corporation, announce in a joint statement that their stockholders had voted to merge the two affiliated companies into a single company to be known as the Sheffield Corporation.

The Sheffield Corporation is the largest inland gage maker in the United States and ranks second in the entire country. At the present time a $1,000,000 addition is nearing completion and will still further increase the production of the new corporation. The combined floor space will total more than 110,000 sq. ft.

The Sheffield Corporation will continue production of the same products, including precision measuring instruments and gages, standard machine tools, special tools and dies. A major portion of its output is used directly in the National Defense Program.

O. M. Poock was elected chairman of the Board of the merged company. Louis Poock, previously general manager of both companies, was elected president and general manager and C. H. Reynolds was elected vice president. No other immediate personnel changes are contemplated at present. Among other officials continuing their former capacities are: Paul Poock, in charge of sales in Machine Tool and Gage Division; Bob Laughter, sales manager, Special Tool and Die Division; Fred Markwick and Ray Mahlmeister, general superintendents.

For Accuracy Speed Economy

COPPER HEAD LAPS

ACCURATE—because of practical scientific design and manufacture.

SPEEDY—because they are always ready and quickly adjustable to size; the abrasive compound of proper consistency works into the copper, the best known lapping medium.

ECONOMICAL—because copper sleeves, the only wearing part, are quickly renewable after long wear.

Available in all standard fractional sizes, 1/8" to 2".

Write For Circular and Prices

BOYAR-SCHULTZ CORPORATION
2112 WALNUT ST., CHICAGO, ILL.

Thirty Precision Operations on One Machine

DESIGNED to minimize set-up operations, the new Hack Multi-Versal toolroom machine performs many precision operations without moving the work piece. Boring, milling, slotting, filing, drilling, grinding, broaching, sawing, duplicating or engraving are all possible on this machine.

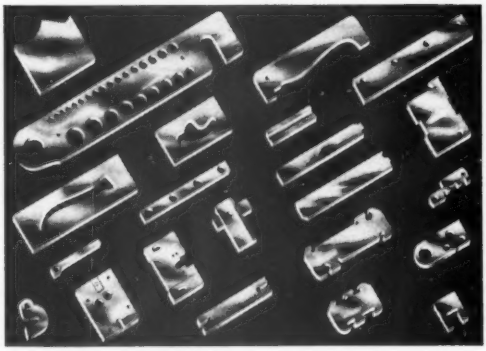
The master head is a horizontal milling unit receiving its power through a V-belt from the motor. Six speeds suitable for driving cutters ranging in size from a 1" end mill to an 8" face mill are provided. The head can be elevated by means of either hand or power feed. Horizontal or vertical jig boring is possible without shifting the jig casting. Vernier scales are built into the machine. A radial drilling attachment is available and is particularly useful on dies where a number of holes are needed. Surface grinding over an area 18" x 24" can be performed with an 8" cup wheel. Contour grinding, gage grinding, cavity grinding, tool and cutter grinding and correction grinding for holes in hardened die parts, where shrinkage or distortion alter center distances, are also practical. For jig sawing die openings, a stub blade saw is used with a high speed slotting attachment. Numerous toolroom set-ups are illustrated in a new booklet entitled "Machines of Tomorrow".

A copy of this booklet will be sent by the Hack Machine Company, Des Plaines, Illinois, upon request. Please specify Booklet TD.

Cleveland Duplex to Handle Upton Salt Bath Furnaces

Announcement of the appointment of the Cleveland Duplex Machinery Company, Penton Bldg., Cleveland, Ohio, to handle the complete line of Upton Electric Salt Bath Furnaces in the Cleveland area is made by Charles R. Pollock, Sales Manager, Upton Electric Furnace Company, 2211 Grand River Avenue, Detroit. The Upton "electrothermic-permeation" principle of operation is said to afford sufficient flexibility to permit the use of the furnaces for virtually any salt bath heating operation requiring temperatures of from 300 to 2500 degrees F.

SAVE GRINDING TIME



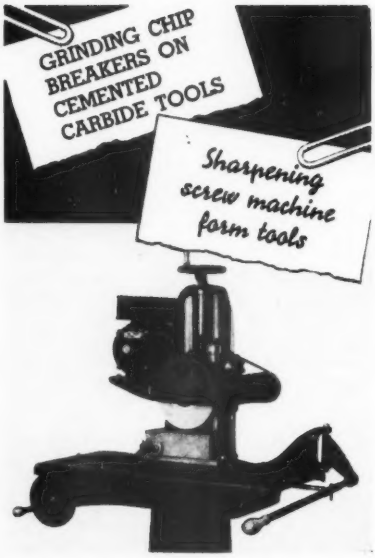
When Making Parts Like These—

Don't tie up men and machines grinding stock for test tools; die, jig, fixture or machine parts; templates; gages; etc. Use Starrett Ground Flat Stock. High grade annealed tool steel, ground to within .001" in thickness, easily machined and heat treated.

Available through your supply house in 18" lengths in a full range of thicknesses. Write for Ground Flat Stock Folder "DM."

THE L. S. STARRETT CO.
WORLD'S GREATEST TOOLMAKERS
Precision Tools...Dial Indicators...Ground Flat Stock
Hacksaws...Metal Cutting Bandsaws...Steel Tapes
ATHOL, MASSACHUSETTS, U. S. A.

STARRETT
GROUND FLAT STOCK
AVAILABLE THROUGH ALL LEADING SUPPLY HOUSES



STOP Doing Your "10c" Grinding Jobs on $2500 Machines!

In all too many cases small picayune jobs hold up expensive grinders!

The "T" Surface Grinder sells itself to the shop man who has 1001 different odd grinding jobs, which have to be done but which can be done easier, quicker and better on this machine built for just such service.

The low price and PROMPT DELIVERY will surprise you. Ask for Bulletin N-644.

BUILDERS . PROVIDENCE
IRON FOUNDRY RHODE ISLAND

New Duro Multiple Spindle Drill Presses

THE new 1941 Duro Production Multiple Spindle Drill Presses are supplied in 2 or 4 spindles. This arrangement enables the operator to perform drilling and tapping operations speedily and economically. Designed to relieve heavier equipment, the new Duro Drill Presses feature all New Departure Ball Bearing construction, heavier head castings and superior construction throughout. Their initial cost is just a fraction of the cost of heavier presses and the power consumption and maintenance costs are practically negligible.

Each spindle runs on 4 sets of permanently lubricated New Departure ball bearings. Splined shafts permit long travel of chuck. Jacobs Chucks take up to ⅝" drill. Equipped with counterweights, belts and motor pulleys. Hinged motor mounting simplifies changing of belt speeds which is accomplished by merely tilting the motor. Heavy 2¾" diameter steel column eliminates vibration. Four spindle table is 20½" x 50". Oil trough 1¾" x 2". Distance between spindles 12" with 7" from chuck to column. Maximum distance chuck to table 26". Cast iron base is extra heavy.

Literature on the new Duro Production Multiple Spindle Drill Presses is now available. Write Duro Metal Products Co., Dept. TP-3, 2649 N. Kildare Ave., Chicago, Ill.

The Nomenclature List in "Plastics Mold Designing" is the largest ever published.

50 Years of Manufactured Abrasives

(Continued from Page 33)

A few years after Acheson's discovery, Charles B. Jacobs made the first aluminum oxide in the electric furnace. Tougher than silicon carbide, but not as hard or sharp, it provided a second base from which abrasives for grinding all types of metals and many other substances could be made. The two substances, silicon carbide and aluminum oxide, still are basic in most manufactured abrasives.

Abrasives have played a very important part in the development of mass production. The accuracy required in precision parts and interchangeability has become commonplace because of abrasives. Grinding has become an established metal working method in removal of material. For many operations abrasives are more efficient than ordinary metal cutting tools. Better finishes and surfaces are easier, quicker and much cheaper with the correct manufacturing abrasive. The effectiveness of standard machine tools themselves has been increased because of the accuracy that grinding, lapping and other abrasive operations have made possible.

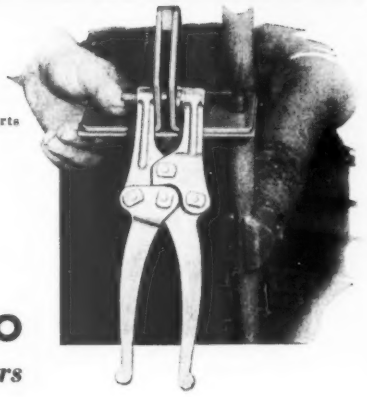
Scherr Appointed Distributor for Wilder Micro-Projector

The George Scherr Company, Inc., announces its appointment as exclusive sales distributor for the Wilder Micro-Projector manufactured by R. S. Wilder, Inc., Waltham, Mass.

The Wilder Micro-Projector is a highly accurate machine for measuring or comparing objects by means of a magnified shadow image. It is widely used for the rapid, accurate inspection of gears, screw threads, punchings and other irregular shaped pieces, such as are used in the manufacture of watches, clocks, typewriters, adding machines, instruments of all types, gages and other equipment. The image is shown on the screen measuring 10½" x 16".

The Wilder Projector is an addition to the present lines of comparators, toolmaker microscopes, Reed Micrometers, Ultra-Chex length standards, GS Dial Test Indicators, GS Machinists' Tools and Tool Chests, and other precision and tool room specialties.

For a copy of Bulletin No. 2T, "Wilder Micro-Projector", write George Scherr Co., Inc., 128-B Lafayette St., New York, N. Y.



Holding pressed metal parts for spot welding

DE-STA-CO

Toggle Pliers

They Have Many Uses

Welding must be swift and sure; and the welding operator is entitled to the best tools that can be supplied. Here is shown a welding operation in which De-Sta-Co Portable Toggle Pliers are used to hold the parts in place.

De-Sta-Co has quick-acting Toggle Pliers, or Toggle Clamps, suited to hold parts during many manufacturing operations . . . Send for Catalog No. 40, which shows photographs of clamp uses.

DETROIT STAMPING CO.

Established Over 25 Years

344 Midland Ave • Detroit, Mich.

CHICAGO MOUNTED WHEELS OF **V/T SUPER BOND**

150% LONGER LIFE

Rigid tests on snagging and exacting operations prove they have 150% to 300% longer life. Won't ridge on welds, sharp corners, sinking dies, barbering, etc. There's a shape and size to handle every grinding job faster, better, at lower cost. V/T Super Bond is the most important development in mounted wheels in 30 years.

Let us send you a trial Wheel. Tell us the kind of job, type of equipment you use and size wheel you prefer.

Free Mounted Wheel Chart

Ideal for ready reference in the shop. A Wall Chart 22 x 15" showing actual size and shape of every standard Chicago Mounted Wheel.

Handee Tool of 1001 Uses

A small "power house" that can be used wherever there is an electric outlet. Grinds, drills, polishes, cuts, routs, carves, sands, saws, sharpens, engraves, cleans, etc. Uses 300 accessories. Weighs 12 oz., 25,000 r.p.m. $18.50 postpaid with 7 accessories.

10 Days Free Trial

Send for catalog of complete line.

Chicago Wheel and Mfg. Co.

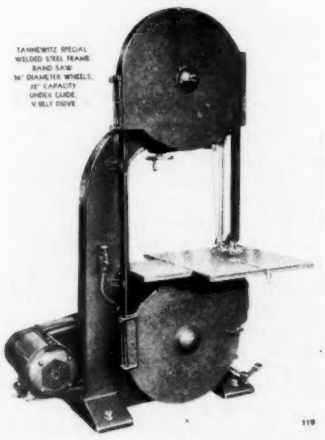
Makers of Quality Products for 40 Years

1101 W. Monroe St., Dept. TD, Chicago, Ill.

Canadian Office - 1332 William St., Montreal

New Tannewitz Band Saw for Cutting Magnesium Blocks; New Deep Throat DI-SAWS

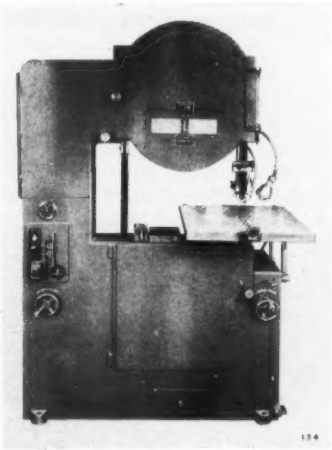
A SPECIAL 36-inch Tannewitz Band Saw with V-belt motor drive for sawing magnesium blocks 30 inches thick is the newest addition to the well known DI-SAW line. Designed for the cutting of pure magnesium and various aluminum alloys, the guide rises above the table more than 36". The motor and multiple V-belt drive with motors mounted on a bracket at the side, offer the most effective means of securing the ideal saw blade travel for the specific material handled.



At the same time the Tannewitz Works, "Sawing Machinery Specialists" for more than a half century, announce a new Tannewitz DI-SAW with a 30-inch throat. Though this throat depth exceeds by six inches that of the standard Tannewitz DI-SAW, it is the smallest of several machines of this type available to meet special requirements.

Tannewitz DI-SAWS having a 36 inch to 48 inch throat capacity, and even larger sizes, can be supplied. All are built along the lines of the standard No. 24M model, which has proven so satisfactory for cutting shoes, dies, templets, filing, polishing and the many other toolroom and die shop operations to which it

is ideally applicable.



Complete information on the Special 36-inch Tannewitz Band Saw for sawing magnesium or the 30-inch Throat DI-SAW is available from the manufacturer, The Tannewitz Works, Grand Rapids, Mich.

Automotive Tool & Die Group to Meet

The Automotive Tool & Die Manufacturers Association of Detroit will hold their Annual Dinner Dance in the Grand Ballroom, Statler Hotel, on Saturday, April 19 at 7 P. M. A big party with lots of fun has been arranged for. Invitations have been extended to officials of several Special Tool, Die and Machine Shop Institute chapters in nearby cities. Chester A. Cahn, secretary of the Automotive Tool & Die Manufacturers Association, states that the preparations indicate the largest gathering ever planned by this organization.

Wells Mfg. Corp. in New Plant

The Wells Mfg. Corp. have moved into their new building, located on the main highway M-60 at Three Rivers, Michigan, ideally situated to serve both the Chicago and Detroit industrial areas. The entire structure is equipped with fluorescent lighting and is air conditioned, providing excellent working con-

(Continued on Next Page)

PRECISION
without
PARALLEL

• BECAUSE Johansson Gage Blocks are accurate to millionth-inch limits, they have become the world's standard of precision measurement. There is scarcely a manufacturing plant in the world doing accurate or interchangeable metal work that does not employ one or more sets.

FORD MOTOR COMPANY
Johansson Division, Dearborn, Mich.

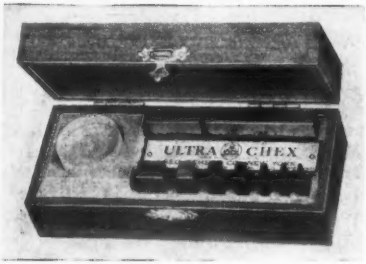
GAGE BLOCKS

ULTRA-CHEX

A NECESSITY in TOOL and DIE SHOPS

Thousands of plants are in production for defense. Never before were precision work, interchangeability and accuracy so essential. Much of this work will be farmed out to small shops. Their work will have to be interchangeable with work turned out by large plants equipped with modern precision instruments.

ULTRA-CHEX will enable your mechanics to work to specified accuracy limits. Rejections, errors, uncertainties and disputes are largely eliminated with ULTRA-CHEX.



The standard ULTRA-CHEX set consists of nine blocks. .0625″—.100″—.125″—.200″—.250″—.300″—.500″—1″—2″. These will give 331 combinations in $\frac{1}{16}$″ and 1/100″ up to $4\frac{7}{16}$″. Price, Ultra-Chex with Optical Flat $25.00. Ultra-Chex only, $19.50.

MECHANICS OWN ULTRA-CHEX set. For tool and die makers who have long wanted a small set of gage blocks we offer this five-block set. With tolerances getting closer, every tool maker should have the MECHANICS OWN ULTRA-CHEX set, which consists of:
.0625″—.125″—.250″—.500″—1″. Price $12.50.

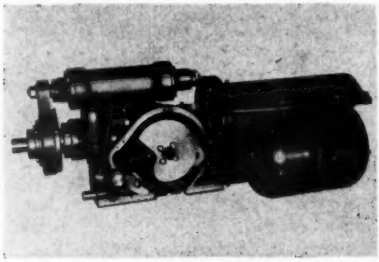
ULTRA-CHEX ARE GUARANTEED ACCURATE WITHIN 8 MILLIONTHS of an inch.

Order now for prompt delivery.

GEO. SCHERR CO. INCORPORATED 128-B Lafayette St. New York, N. Y.

Enterprise Buys Millholland Patents, Improve Production Units

THE Enterprise Machine Parts Corporation, Detroit, announces the purchase of the Millholland patent rights covering the design of these well-known units. Redesigned and with many notable improvements which have stepped up their efficiency, these units will be marketed as "Empco Units".



Empco Units lend themselves to a wide diversity of applications—for drilling, milling, tapping, reaming and spotfacing (either singly or in multiples), and are used to form machines for speedy production.

These units are designed especially for heavy work. A plate has been removed from the unit illustrated to show the cam. The specially designed cam which utilizes the pneumatic counterbalance to best advantage, makes possible the great speed at which these units perform. This cam has a chip cutting efficiency of 80 per cent to 88 per cent.

The use of plate type cams, simple feed, and speed gears, plus the interchangeability of the same sized units and parts, permits change-over at the minimum cost. Full automatic cycle with interlocked controls permits exceptional extensions of groups of units.

New literature giving full information on the new Empco Units (Millholland Patents) is now ready for distribution. For your copy write Enterprise Machine Parts Corp., 2735 Jerome Ave., Detroit, Mich.

Wells Mfg. Corp in New Plant

(Continued from Page 43)

ditions. With the increased facilities The Wells Corporation will now be in a better situation to serve both the regular customers and to handle their share of the Defense Program work.

For coarse cuts . . . . or fine cuts . . . .

AMERICAN SWISS

FILES OF PRECISION

More than 3000 shapes, cuts and sizes

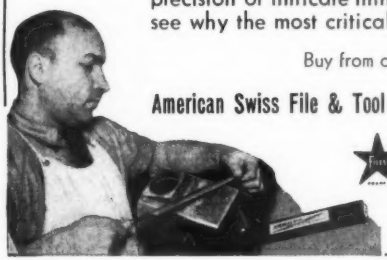
assure best results in least time, because of the uniformly hard, deep, sharp teeth in the extra-long filing surface of these files.

Swiss-Pattern Files Made in U.S.A.

Try an "American Swiss" Swiss-Pattern File on any precision or intricate filing job, and you will quickly see why the most critical file users prefer them.

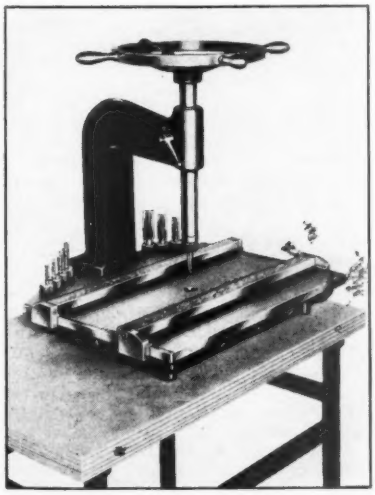
Buy from our Distributor

American Swiss File & Tool Co. **Elizabeth, N. J.**



The VIKING TAPPER—

A PRECISION BUILT TOOL



Base, semi-steel casting, well ribbed and seasoned to prevent warping.
Two sliding parallel bars to hold work in place while tapping.
Quick changing adaptors, requiring but 5 seconds to change tap.
Steel spindle hardened, ground and lapped to a perfect gage fit.
Spindle lock for holding spindle in position.
Two spindle bearing bushings hardened, ground and lapped.
Aluminum handwheel with four inserted steel handles.
Bracket arm, semi-steel casting bottom scraped to insure spindle is perfectly square with base.

Capacity ¼" to ⅜".

Send for Circular

THE VIKING TOOL & MACHINE CORP.

6 Main St. Belleville, N. J.

Recent Industry Publications

"DISC GRINDING"—designated as Form 1141-3P, is a practical and thorough discussion of the advantages and procedure of disc grinding. Various types of applications are illustrated with instructions for step-by-step procedure to follow. Tables of recommendations and mounting instructions are also given. For a copy of this booklet address Norton Company, Worcester, Mass.

"LET IN THE LIGHT WITH WESTERN TRANSMISSIONS"—this 4-page circular shows a number of typical applications of the two models of transmissions developed by Western Mfg. Co., 3430 Scotten Ave., Detroit, Mich., for motorizing machine tools. Write for your copy of this circular.

WELLS METAL CUTTING BAND SAW—a new circular illustrates and describes the two sizes of the latest Wells Metal Cutting Band Saw. Outstanding features, including three speeds, positive control of gravity feed by hydraulic frame check, simplicity of design and greatest capacity in its popular price class, are detailed. A list of users of two or more Wells Metal Band Saws is given. Address your request for this circular to Wells Mfg. Corp., Three Rivers, Mich.

SUPER SENSITIVE VARIABLE SPEED DRILLING MACHINE—the Hamilton-Muehlmatt Varimatic Super Sensitive Variable Speed Drilling Machine, the standard all over the world for a generation, is fully described in Bulletin "MV". Speed adjustment infinitely variable in two ranges of speeds provides "instrument precision" for drills down to .004". If you do precision drilling in small sizes the Varimatic is the machine you will eventually buy. Write A. Muehlmatt Div. of The Hamilton Tool Co., Ninth and Hanover Sts., Hamilton, O., for your copy of Bulletin "MV".

SEVERANCE TOOLLOG NO. 13—this newest Bulletin shows representative cutters of this company's line of Midget Milling Cutters. Included are several of the new rotary cutters and inside and outside deburring cutters. Full instructions for ordering are given. For your copy of Severance Toollog No. 13 write Severance Tool Co., Saginaw, Mich.

EMPCO DRILLING AND TAPPING UNITS—a new, illustrated circular describing the line of Empco Standard Units built under Miliholland patents, gives a partial list of users and the operations performed with these units in a wide variety of industries. Specifications and attachments are also listed in this new circular. For your copy address Enterprise Machine Parts Corp., 2735 Jerome Ave., Detroit, Mich.

"HOTTER THAN A DEPOT STOVE"—Bulletin, IF-241, issued by Johnson Gas Appliance Co., shows the pot hardening and melting furnace, the high speed steel furnace and the new fast heat treating furnaces available in both pedestal and bench types. Full specifications and prices, and shipping instructions are given. Bulletin IF-241 will be sent on request. Write Johnson Gas Appliance Co., 611 E Ave., N. W., Cedar Rapids, Iowa.

"WET-DRY BELT GRINDING"—this booklet is a fundamental and practical treatise on belt grinding practice. Giving procedure details in the shopman's own language, the several types of new Porter-Cable belt grinders, including a model for grinding irregular surfaces, are illustrated and described. Other types of Porter-Cable equipment include universal milling attachments. For your copy of "Wet-Dry Belt Grinding" write Porter-Cable Machine Co., 104 Wolf St., Syracuse, N. Y.

UNIVERSAL STANDARD DRILL BUSHINGS—Catalog HT contains complete data for the shop on the six types of Universal Standard Bearings, as well as locating pins, retainers, clamps and lock screws made by this company. A separate price list is furnished with the catalog. A sketch pad for convenience in specifying details of either head or headless type bushings will also be sent on request. For Catalog HT, price list and sketch pad write Universal Engineering Co., Frankenmuth, Mich.

PORTABLE BRINELL METER—the improved Model B Brinell Meter, a portable hardness tester, is the subject of a new Folder issued by Louis C. Eitzen Co., 280 Broadway, New York, N. Y. Impressions are made simultaneously in a reference bar and the material to be tested. The impression diameters are compared by reference to a Direct Reading Hardness Table provided for the reference bar—thus obtaining a Brinell reading quickly. A copy of Folder "T" will be sent at your request by the Eitzen Company.

M-B "UTILITY" PNEUMATIC GRINDER—Bulletin 1002 gives full specifications and details of design of Model U-T.R., the new M-B "Utility" Pneumatic Grinder, a 60,000 RPM hand tool designed for tough precision and production jobs. A card to M-B Products, 132 E. Larned St., Detroit, Mich., will bring you a copy of Bulletin 1002.

BRISTOL SOCKET SCREWS—catalog 846-T is the newest edition showing the complete line of Bristol socket screws, socket set and cap screws and Hex socket set cap screws. The new catalog is well illustrated with complete specifications and prices. Tables of packing weights are also included. Your copy of Catalog 846-T will be sent promptly on request. Write Bristol Company, Mill Supply Div., Waterbury, Conn.

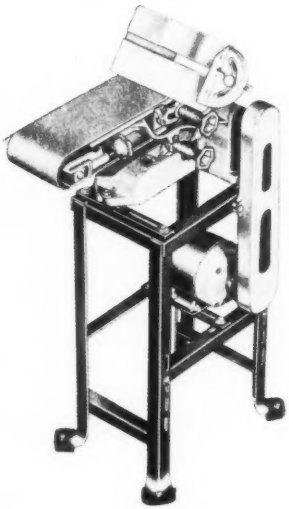
REID SURFACE GRINDERS—a new Bulletin gives standard specifications and features of design in detail for three machines in the Reid line. The Automatic Feed Surface Grinder, the Automatic Feed Surface Grinder with Hydraulic Reverse and the Hand Feed Surface Grinder are all described and illustrated. For your copy of this Bulletin write H. Leach Machinery Co., 387 Charles St., Providence, R. I.

NEW EX-CELL-O PRECISION BORING MACHINES—Five new folders illustrating the five standard Ex-Cell-O machines for boring, turning, facing, etc., have just been printed and are now ready for the trade. Bulletin No. 31201 on the Junior Single End, Bulletin No. 31101 on the Junior Double End, Bulletin No. 31301 on the Senior Single End, Bulletin No. 31401 on the Senior Double End and Bulletin No.

(Please turn to Page 48)

Duro 6" Vertical and Horizontal Belt Sander

THE Duro 6" Vertical and Horizontal Belt Sander, a pioneer development with this company, is a sturdy, versatile unit for producing smooth, precision finishes on metals, plastics or woods quickly and economically. The belt type sander cuts evenly across the entire face of the belt, an advantage not possible with the



disc type. The Duro design belt carriage permits either horizontal or vertical sanding. The table, with mitre gage, can be set square, tilted up to 45 degrees in one direction, 5 degrees in the other direction or may be removed. Compound angles are obtained by using the mitre gage with the table tilted. Belt tension and belt alignment are easily and quickly adjusted by hand knob on either side of the upper end of the machine. Many metal working operations are conveniently and economically performed by using emery sanding belts.

The Duro sanding drums are rubber covered — a double advantage as they permit the belt to run at less tension without slipping, giving longer bearing and belt life and the rubber acts as a cushion to the belt, absorbing strain and

(Continued on Page 52)

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Stand for Quality

We were the Originators of HIGH CARBON-HIGH CHROME Steels with NON-DEFORMING Qualities, opening the way to

Quantity Production

with all kinds of Dies and Press Tools

Oil-Hardening
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Air-Hardening
"COBALTCROM-PRK"
—the latter also in CAST FORM

have become the STANDARD on which all subsequent similar kinds of Steel were based.

We supply also

High Speed Steels

in Bars, Forgings, Tool-Bits as well as all types of

High Grade Tool Steels

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WELDING RODS

Save time and money in die repair or tool redesigning as used in Precision-Welding.

Full particulars on request

DARWIN & MILNER, Inc.

1260-64 W. 4th St. Cleveland, O.

Recent Industry Publications

(Continued from Page 46)

31501 on the Extra Heavy Duty Senior Double End Ex-Cell-O Precision Boring Machines each give general specifications of the machine; lists and illustrates representative applications. One or more of these Bulletins will be sent on request. State your problem if you are not certain which machine will meet your requirements. Address Ex-Cell-O Corporation, 1206 Oakman Blvd., Detroit, Mich.

UNBRAKO SCREWS—Catalog 558-T gives full data on the line of "Unbrako" screws—socket, head cap, locking socket, socket head, hollow set and others. Shop and engineering data, specifications, prices and packing and weight schedules make ordering from the Catalog easy and convenient. A copy of Catalog 558-T will be sent at your request. Address Standard Pressed Steel Co., Box 600, Jenkintown, Pa.

"MASTER-DRAFTO" MODEL NO. 60—a new 4-page folder describing this low priced drafting machine has just been issued by the Drafto Co., 259 Walnut St., Cochranton, Pa. This folder contains information as to construction, operation details and prices of the "Master-Drafto" Model No. 60 drafting machine, designed for center mounting on a drawing board or table. Taking a maximum size drawing sheet 24" x 36", it features scale blades designed to hold any standard size scale. The protractor device, which can be set for ½ degree readings, has a convenient latching spring for locking the scales at the more commonly used angles. Copies of this new literature will be furnished gratis upon request.

FORRESTER METAL ATOMIZER—a metal atomizer and spraying machine, a combination of a metal furnace and a spraying apparatus, is particularly useful for metal veneering of patterns, experimental dies, jigs, fixtures, stencils and templets. It can use Cerrobend or Cerrobase. For a copy of this circular write Forrester Specialty Co., 13304 Jefferson Ave., E., Detroit, Mich.

VIMCO—"THE LIGHT ON THE SPOT"—a 4-page Bulletin illustrates the standard stock combinations of machine lights, Vimco sockets, base assemblies and reflectors offered by this company. Many types of installations are also shown. A copy of this Bulletin will be sent on request. Write Vimco Mfg. Co., Inc., 111 Chenango St., Buffalo, N. Y.

MODEL A600 TOOL AND CUTTER GRINDER—Bulletin TCG-42 shows more than a dozen actual set-ups of toolroom work on this Tool and Cutter Grinder. With standard equipment, straight, spiral or angular milling cutters, face or form milling cutters up to 6¼" in diameter can be sharpened; as well as straight, taper, spiral and helical cutters; and slitting saws up to 24". Extra fixtures for tap grinding and for cylindrical and internal grinding are available. For a copy of Bulletin TCG-42, write K. O. Lee Co., Aberdeen, S. D.

ULTRA LAP MACHINES—a folding Bulletin lists essential data on three of the Ultra Lap Machines and illustrates a few of many varied parts regularly surface-finished on these machines. The Ultra Lap can produce surfaces to one light band (12 millionths of an inch) for flatness and as low as one micro-inch R.M.S. for smoothness. For a copy of "Ultra-Lap Machines" Bulletin, write Ultra-Lap Machine Co., 247 McDougall Ave., Detroit, Mich.

"CAPEWELL METAL CUTTING SAWS"—Bulletin No. M139D, gives the specifications of the Capewell Hack Saw Blades and Band Saw Blades. This company offers a complete line of high speed, hard steel tungsten and spring temper saws. Very useful general information, as well as a chart of teeth, weight of feeds and speeds is included. For a copy of Bulletin M139D write Capewell Mfg. Co., Hartford, Conn.

DIAMOND TOOLS—Catalog size sheets show multiple diamond tools for rough and semi-finish dressing, form tools for radius dressing, boring and turning and other diamond tools. Prices are shown for most tools. This company offers a consulting service on both diamond tools and wheels or machines. For literature or answer to a cutting problem, write Maurice S. Dessau and Co., 6 Maiden Lane, New York, N. Y.

THE AUTOMATIC QUICK ACTING VISE—an 8-page illustrated booklet shows this recently introduced automatic vise and clamping tool which is practical for production or variable shop work, and which uses foot pedals for clamping and releasing work—freeing both hands. The Automatic Vise is sold with a Money Back Guarantee by the Automatic Vise Sales Co., 2843 Sunset Place, Los Angeles, Cal. Write for your copy of this booklet.

NEW CARBOLOY CATALOG—a new 8-page catalog, GT-129, showing complete specifications and prices of the low priced standard tools now available and to be carried in stock in grades from machining steel, cast iron, non-ferrous metals, etc., is now ready for distribution. Photographs and dimensional drawings make this catalog very practical. Prices and specifications of Carboloy Standard Blanks, available in 2 styles, 65 sizes and 2 grades, are included. For your copy of Catalog GT-129 write Carboloy Co., 11122 E. 8 Mile Ave., Detroit, Mich.

UNITED STATES ELECTRIC TOOL CATALOG NO. 56—this 72-page Catalog lists the wide range of hand, bench and floor grinders, drills, rotary files, screw drivers, surfacers and other similar equipment of this company. Full specifications and prices are given. For a copy of Catalog No. 56, write United States Electrical Tool Co., Cincinnati, O.

UNIVERTICAL HIGH SPEED END MILLING MACHINE—a new Bulletin on this bench type vertical end milling machine, equipped with swivel head and four-speed range from 850 to 3400 RPM, is being distributed to the trade. For a copy of Univertical Bulletin T, write Univertical Machine Co., 618 St. Antoine St., Detroit, Michigan.

Suggestions on Drilling Procedure

(Continued from Page 27)

spin as a drill breaks through and the rubbing action destroys the cutting edge. The chips are very tough and for normal and more economical working conditions, materials should be removed up each drill flute as one continuous chip, unbroken from beginning to end. Deep hole drilling in high manganese steel generates much heat, the drilling of a hole 3 diameters in depth developing excessive tool wear unless the part is removed and cooled before proceeding with deeper drilling.

The full length of a deep-hole or gun drill should have a single flute occupying slightly more than one-quarter of the drill's cross-section. The flute is usually straight and parallel to the length of the drill. The outside diameter is the remainder of a ground cylinder which has a diameter equal to the desired hole size. The drill is provided with an oil hole throughout its length. The oil is delivered under high pressure. These drills are guided by a bushing or a hole is formed to the size of the drill and to a depth of more than the length of the leveled end of the drill. These drills cut close to their diameter size due to the use of one cutting area as compared to the two cutting areas of a two-lip drill. The use of gun drills involves end cutting, a free, keen cutting action being necessary for the full-size formation of the hole. The speed is governed by the working conditions. A speed of 50 to 70 per cent of that used for a two-flute drill is satisfactory for the usual working conditions. Light chips are removed by the application of a light but positive feed. Here slow feeds are used to prevent tearing of the part material and the development of inefficient cutting with its wedging of the tool, roughness, abrasion, etc.

Special Drilling Conditions

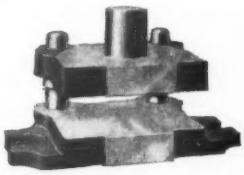
As drills increase in size there is a greater tendency toward side play of the cutting edge as the tool moves in its irregular force path. This leads to side movements which develop into chatter. A reduction in the cutting speed is required to decrease the force of this side movement. These speed reductions are

(Continued on Next Page)

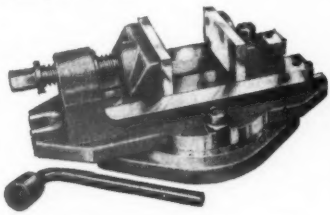
News for Die Makers—

Producto Die Sets

Are now within 12 to 24 hour delivery of nearly every die building shop — Producto Interchangeable Master and Standard Die Sets in hundreds of combinations for practically every class of work.



A complete line of accessories — Guide Pins, Bushings, Stripper Bolts, Socket Head and Socket Set Screws, Dowel Pins and Springs. Attachments and tools include Dickerman Hitch and Die Feeds, Bay State Hand Tapper and Vise and the Producto Utility Press.



Producto Machine Vises include the 4½″ general purpose vise (illustrated) and a 6″ heavy duty vise. *Ask for Vise Circular.*

A line of standardized Producto Set-Up Tools, with applications, is described in a new Bulletin.

Write or wire for location of nearest stock point — Catalog will be sent on request.

The PRODUCTO MACHINE Co.

930 Housatonic Ave. Bridgeport, Conn.
3017 Medbury Ave. Detroit, Mich.

Suggestions on Drilling Procedure

(Continued from Page 49)

given in *Table No. 3-1, "Speed and Feed for Drilling and Reaming". Drills in the range between 1¾ inch and 3 inch diameters require considerable power for their operation. The drilling of a large diameter hole (1¼ inches and over) is usually preceded by the drilling of a small hole which thus has removed the part material which would be under the chisel-point end of the larger diameter drill. The smaller drill should be ⅜ to ½ inch in diameter, such sizes having sufficient strength to withstand such service. Where this expedient is not applied the drilling feed for drills over 1¼ inch diameter requires a 50% (or more) feed reduction. The hard and tough part materials require the use of smaller drills before the larger drills can be applied to the material efficiently. After using the small drill the large drill acts like a large chamfering tool. It steadies itself in the cut and little chatter will develop where sufficient feed is applied. Holes larger than 3-inch diameter are not economically drilled. They are usually cored or drilled to 3-inch diameter and then bored to size.

The soft, easily penetrated materials (fiber, micarta, soft plastics, etc.) have their large holes cut by counterboring or trepanning. First a pilot and later the outer edge of the hole act as a support in the cutting action. The extreme work-hardening materials (stainless steel, etc.) are subject to glazing and they retard further advance of the drill point. This condition may be prevented by maintaining a positive feed of sufficient depth so that a full-bodied chip is formed by the cutting lips. After the condition has developed it can be overcome by nicking the glazed surface with a cold chisel and thereby breaking up complete resistance to the cutting edges of the drill. The use of a square or triangular center punch at the point where the drill begins the drilling of the hole will prevent development of this condition. The punched center should be of a minimum depth and produced with a single blow of the hammer.

The use of a hand feed for drilling small holes requires a sensitive machine which is run with a light feed and a high speed. Spindle speeds up to 30,000 RPM are used effectively in such small hole drilling. The limiting factors are the bearings, belts and the balance of the spindle and drill chuck. Where drills are used in sets within a multiple head

**In forthcoming "Feed and Speed Handbook".*

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END MILLS
KEY WAY CUTTERS
Universal Collet Chucks grip as strong as solid steel on flutes or shanks of drills, end mills, keyway cutters, etc. Write for facts and prices.
UNIVERSAL
Engineering Company
Frankenmuth, Mich.

or where the drill dulls rapidly and many changes are made, the use of a drill grinder will maintain these drills to one length and eliminate the time necessary to set the depth stop or extension for each drill. The forming of the drill point with equal angles and lengths of cutting lips, sufficient clearance, etc., is particularly important where the drill is used without a drill bushing as a guide. Oversize cutting, drill cutting-edge wear and errors in alignment of the hole and the drill are greatly increased without these refinements.

Sleeper & Hartley Acquire Air Vise

Sleeper & Hartley Company, Worcester, Massachusetts, manufacturers of automatic spring-making machinery, announce the acquisition of both manufacturing and sales rights to the Larkin Air Vise. Five standard and one quick mounting model comprise the Larkin line. These pneumatically operated vises, although designed for production work, are well suited for many tool room applications. J. L. Seat, inventor of the Larkin Air Vise, has joined the Sleeper & Hartley organization.

Remove
BROKEN TAPS

Quickly
Insert WALTON Tap Extractor and back out broken piece. No annealing—no drilling.

Easily
Tap Extractor and Tap Wrench are only tools needed.

Safely
Threads are not damaged. Not necessary to tap oversize after broken tap is removed.

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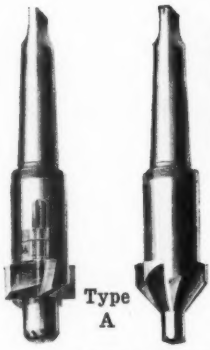
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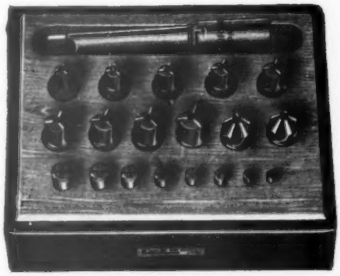
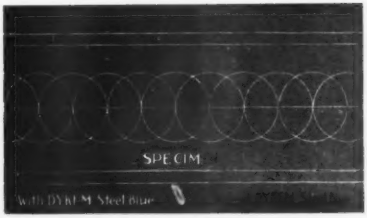
Seven different sets available, with assorted counterbores, pilots and holders assembled in sturdy wooden tool cases. The set illustrated here consists of one holder, counterbores from ¼" to ½", pilots from $\frac{5}{32}$" to ⅜", countersinks ½" dia. 70° and 82°. Write for catalog and prices.



THE GAIRING TOOL CO.
Detroit, Michigan



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Write for full information.

THE DYKEM COMPANY
2201 N. 11th STREET ST. LOUIS, MO.

Duro Belt Sander

(Continued from Page 47)

materially prolonging the life of the belt.

The open ends of the 6" Duro Sander have four advantages—long pieces may be passed over the work table; the drum may be used for curved surfaces; the unsupported side of the belt may be used for sanding irregular surfaces; the supported side for sanding inside corners.

The illustration shows the 6" Sander set for a horizontal operation. Note the substantial angle frame mounted on rubber feet, the heavy gray iron construction of the tilting table that insures rigidity and the operating convenience of the mitre table and hand locking knobs. One knob locks the table, the other locks the machine in the horizontal or vertical position. Self lubricating bronze bearings were chosen to give lower maintenance costs and to permit the machine to be produced and sold at a lower price.

For complete information on the Duro 6" Vertical and Horizontal Belt Sander write Duro Metal Products Co., Dept. TP-3, 2649 N. Kildare Ave., Chicago, Ill.

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- This directory of products lists for ready reference the names of manufacturers and dealers whose sales to The TOOL and DIE Journal readers have established them as dependable in every sense of the word. They merit your consideration.
- Complete information about any product may be had upon request made to the firm listed or to us.
- Your mention of The TOOL and DIE Journal will be appreciated.

ABRASIVE PAPER AND CLOTH
Carborundum Co., Niagara Falls, N. Y.
Norton Co., Worcester, Mass. (Behr-Manning Div.)

ASSEMBLING MACHINES—Automatic
Sommer & Adams Co., The, 18511 Euclid Ave., Cleveland, Ohio.

BAND SAWS—Metal Cutting
Starrett Company, L. S., Athol, Mass.
Wells Mfg. Corp., Three Rivers, Mich.

BAR STOCK—Heat Treating
Lakeside Steel Improvement Co., 5418 Lakeside Ave., Cleveland, Ohio.

BARS—Rolled Composite
Forging and Casting Corp., Ferndale (Detroit), Michigan.

BENCHES
Challenge Machinery Co., Grand Haven, Mich.

BLOWERS
Johnson Gas Appliance Company, 611 E Avenue, NW, Cedar Rapids, Iowa.

BOLTS—Stripper
Allen Mfg. Co., Hartford, Conn.
Holo-Krome Screw Corp., Hartford, Conn.

Danly Machine Specialties, Inc., 2121 So. 52nd Ave., Chicago, Ill.
Die Supply Co., 1390 E. 30th St., Cleveland, Ohio.

BORING HEADS—Offset
Precision Tool Co., The, P. O. Box 155, Brooklyn, N. Y.

BROACHING PRESSES—Standard and Utility
Colonial Broach Co., 147 Jos. Campau, Detroit, Mich.

BURNERS—Gas
Johnson Gas Appliance Company, 611 E Avenue, NW, Cedar Rapids, Iowa.

BUSHINGS—Die
Acme Industrial Co., 206 No. Laflin St., Chicago, Ill.
Danly Machine Specialties, Inc., 2121 So. 52nd Ave., Chicago, Ill.
Danneman Company, F. C., 203 Lafayette St., New York, N. Y.
Die Supply Co., 1390 E. 30th St., Cleveland, Ohio.

BUSHINGS—Drill
Universal Engineering Co., Frankenmuth, Mich.

CALIPERS
L. S. Starrett Co., Athol, Mass.
Lufkin Rule Co., Saginaw, Mich.

CAMS
Gorton Machine Co., George, 1319 Racine St., Racine, Wisconsin.

CAP SCREWS—Flat Head
Allen Mfg. Co., Hartford, Conn.

CAP SCREWS—Socket Head
Allen Mfg. Co., Hartford, Conn.

CARBIDE TOOLS AND BLANKS
Ex-Cell-O Corporation, 1206 Oakman Blvd., Detroit, Mich.
Gairing Tool Co., The, 1631 Lafayette Blvd., Detroit, Mich.
McKenna Metals Company, 500 Lloyd Ave., Latrobe, Pa.
Motor Tool Mfg. Co., 12283 Turner Ave., Detroit, Mich.

CASTINGS—Air and Oil Hardening Tool Steel Cast to Shape
Forging and Casting Corp., The, Ferndale (Detroit), Mich.

CASTINGS—Nitri-Cast-Iron
Forging and Casting Corp., The, Ferndale (Detroit), Mich.

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CLAMPS—Toggle
Danly Machine Specialties, Inc., 2121 So. 52nd Ave., Chicago, Ill.
Detroit Stamping Co., 344 Midland Ave., Detroit, Mich.
Knu-Vise, Incorporated, 16841 Hamilton Ave., Highland Park, Michigan.

CLAMPS—Toolmakers
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COMPOSITE DIE SECTION STEEL
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Wayne Chemical Products Co., 9425 Copeland Ave., Detroit, Mich.

COMPOUNDS—Cutting
Wayne Chemical Products Co., 9425 Copeland Ave., Detroit, Mich.

COMPOUNDS—Driving, Drawing, Stamping Metal
Wayne Chemical Products Co., 9425 Copeland Ave., Detroit, Mich.

COMPOUNDS—Grinding
Wayne Chemical Products Co., 9425 Copeland Ave., Detroit, Mich.

CONTOUR METAL-WORKING MACHINES
Continental Machines, Inc., 1303 S. Washington Ave., Minneapolis, Minn.

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Allen Mfg. Co., Hartford, Conn.
Putnam Tool Co., 2985 Charlevoix Ave., Detroit, Mich.

CRANKSHAFTS—Heat Treated for Presses
Enterprise Machine Parts Corp., 2735 Jerome Ave., Detroit, Mich.

CUTTERS—Die-sinking
Gorton Machine Co., George, 1319 Racine St., Racine, Wisc.
Tomkins-Johnson Co., The, 630 North Mechanic St., Jackson, Mich.

CUTTER GRINDERS
Gorton Machine Co., George, 1319 Racine St., Racine, Wisconsin.
Oliver Instrument Company, 1436 Maumee St., E., Adrian, Michigan.
Norton Company, Worcester, Mass.

CUTTERS—Hard Carbide
McKenna Metals Co., 500 Lloyd Ave., Latrobe, Pa.

CUTTERS—Milling
Gairing Tool Co., The, 1631 Lafayette Blvd., Detroit, Mich.
Motor Tool Mfg. Co., 12283 Turner Ave., Detroit, Mich.
Putnam Tool Co., 2985 Charlevoix, Detroit, Mich.
Severance Tool Mfg. Co., 1506 E. Genesee Ave., Saginaw, Mich.
Tomkins-Johnson Co., 630 N. Mechanic St., Jackson, Mich.

CUTTING TOOLS
National Twist Drill and Tool Co., Detroit, Mich.

CYLINDERS—Hydraulic
Tomkins-Johnson Co., 630 N. Mechanic St., Jackson, Mich.

CYLINDERS—Pneumatic
Tomkins-Johnson Co., 630 N. Mechanic St., Jackson, Mich.

DIAMOND STONES
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Norton Company, Worcester, Mass.

DIAMOND TOOLS
Koebel Diamond Tool Co., 9350 Grinnell, Detroit, Mich.

DIAMOND WHEELS
Carborundum Co., Niagara Falls, N. Y.
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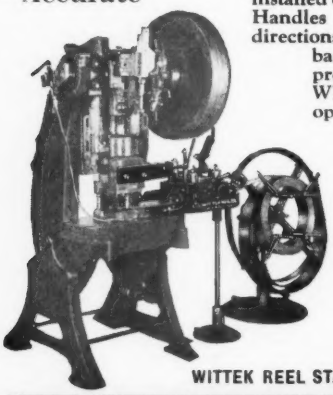

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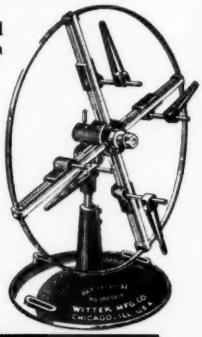

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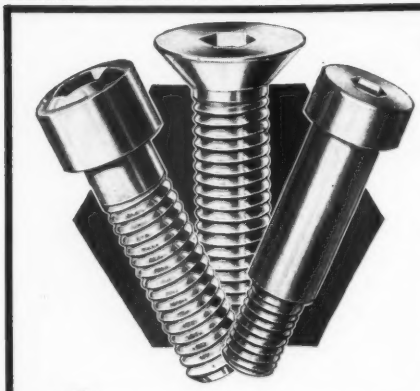

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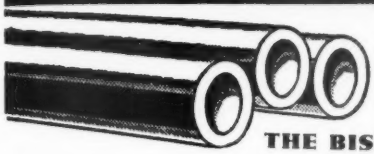

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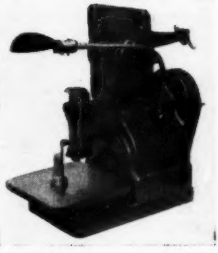

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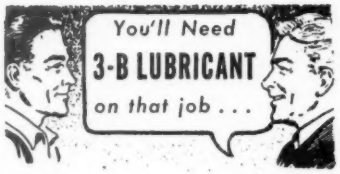

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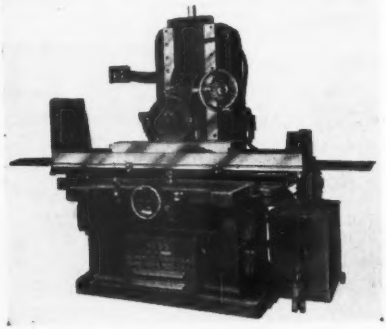

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(Continued from Page 59)

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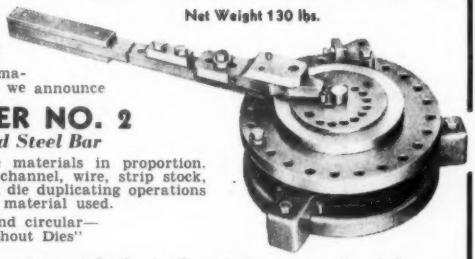

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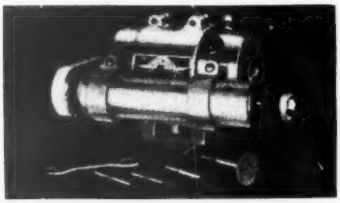

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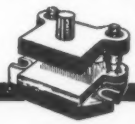

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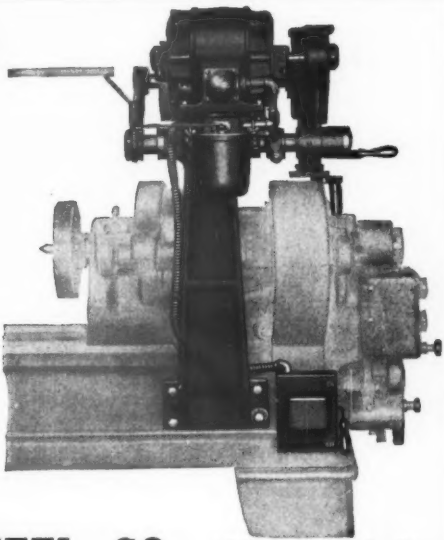

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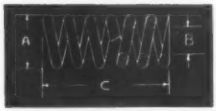

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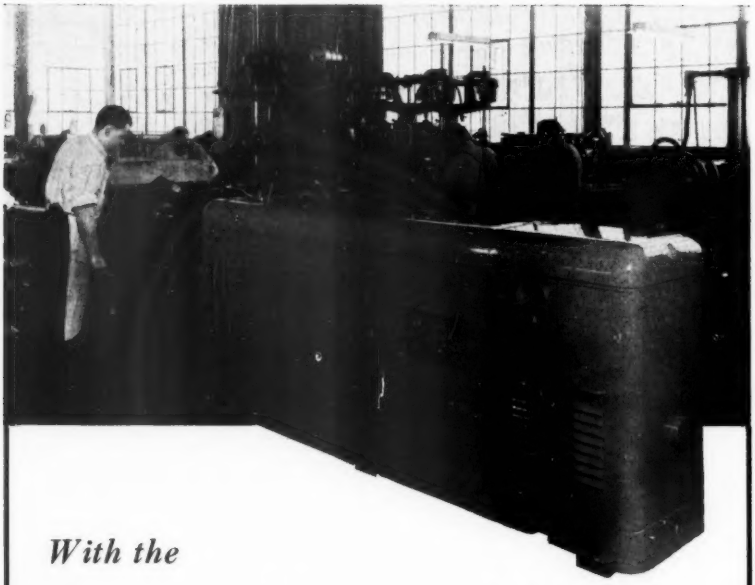

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